SAN FRANCISCO

MUNICIPAL REPORTS

FOR THE

FISCAL YEAR 1914-15, ENDED JUNE 30, 1915

PUBLISHED BY ORDER OF THE

BOARD OF SUPERVISORS

SAN FRANCISCO
NEAL PUBLISHING CO., 66 FREMONT ST.
1917

BUREAU OF ENGINEERING

San Francisco, August 30, 1915.

To the Honorable The Board of Public Works
of the City and County of San Francisco.

Gentlemen:—Herewith is transmitted the Annual Report of the Bureau of Engineering for the fiscal year 1914-1915.

Satisfactory progress has been made on all of the construction work being performed under the direction of this Bureau, and on the projects under contemplation.

No work that has been undertaken in recent years will have a more stimulating effect on the growth of San Francisco than the Twin Peaks Tunnel. Work on its construction was begun on November 30, 1914. During the seven months intervening between that date and the end of the fiscal year 1600 lineal feet of excavation and 1000 lineal feet of tunnel lining were completed at the westerly end. The underground Eureka Valley Station and 1300 lineal feet of excavation at the east and west were constructed, and excavation for the Laguna Honda Station was 60 per cent completed. If the same rate of progress can be maintained on the remainder of the work, the contract should be finished by March, 1917, when 10,000 acres of very desirable residence property hitherto inaccessible will be brought within the twenty minutes transit zone whose center is at Kearny and Market Streets. The estimated value of the Twin Peaks Tunnel work completed on June 30, 1915, was $713,860.73.

During the past fiscal year the Stockton Street tunnel was also finished. By its construction access has been provided to the North Beach district, which has great possibilities as a manufacturing section. The running time for Municipal cars from Fourth and Market Streets to the Panama-Pacific Exposition grounds has been materially reduced by this tunnel. The contract was accepted on December 11, 1914, and $415,960.39 was paid to the contractor.

A most important addition has been made to San Francisco's sewer system by the completion of Mile Rock Tunnel. This furnishes an outlet for storm water from the entire Sunset District and from portions of the Richmond and Ingleside Districts. Its completion will relieve conditions which have been the subject of complaint, and provide adequate drainage facilities to much valuable property. To remove domestic sewage from this main outfall a pumping station has been completed beneath the intersection of 48th Avenue and Fulton Streets. This station discharges into a 24 inch cast iron pipe which conveys the sewage through the Richmond District to Baker's Beach, where it discharges twenty feet below the surface by means of a submerged pipe 800 feet from shore.

On the Auxiliary Fire Protection System the principal work completed during the year was the Central Fire Alarm Station. This is most adequately equipped fire alarm building in the United States, and is provided with every conceivable practical safeguard against fire and earthquake.

In no year during the City's history has such progress been shown in boulevard construction as in 1914-1915. The completion of Junipero Serra Boulevard, a portion of the Bay Shore roadway, Portola Drive, Sloat Boulevard, portions of Nineteenth Avenue and the Camino del Mar, are but disjointed units of one comprehensive system projected by this office, the complete accomplishment of which can be expected within the next two years. When finished, it is doubtful if any city in America, not excepting Washington, D. C., will be more adequately provided with scenic boulevards.

Approximately twenty miles of track for the Municipal Railways have been constructed since June 30, 1914. The quality of the roadbed and equipment have been proven by its pronounced efficiency in handling the heavy Exposition traffic, and the success of the entire project, both from an operating and financial standpoint, has been demonstrated to the most skeptic. A total of $1,479,737.21 has been expended on Municipal Railway construction during the past fiscal year.

Preliminary work on the Hetch Hetchy project has been advanced to the stage where contracts can be awarded at once for the grading and laying of 67 miles of construction railway, the erection of a diverting dam, and the boring of the tunnel to by-pass the Tuolumne River around the dam site, while the main Hetch Hetchy dam is being constructed. I have already completed the design of the main dam, and hope to begin its construction during 1916. A sawmill has been erected by the City at Canyon Ranch, to provide lumber for tunnel timbers, concrete forms and camp buildings. Nine miles of the main transportation road have been graded at a cost of approximately $190,000. Numerous other roads in Hetch Hetchy Valley, all of which are later described in this report, have been completed.

I desire especially to direct the attention of your Board to the fact, that the efficient work accomplished has in a large measure been due to the unselfish devotion to their duties of the assistant engineers and especially Principal Assistant Hunt and Consulting Engineer Ransom.

The following is a detailed report of all of the work accomplished under the direction of this Bureau during the past fiscal year.

Respectfully submitted,

M. M. O'SHAUGHNESSY,
City Engineer.

TWIN PEAKS TUNNEL.

The principal features of the design of the Twin Peaks Tunnel were fully described in the last Annual Report of the Bureau of Engineering. The project is the largest thus far undertaken in any city for the extension of a street railway system. The length of the completed bore will be 12,800 feet, the width 25 feet in the clear, and the clear height above the top of the rail 15 feet. On its completion, over 10,000 acres of very desirable residential territory, now isolated by inaccessible hills and by reason of inadequate street railway facilities, will be brought into rapid communication with the downtown district.

On November 12, 1914, a contract for the construction of the tunnel was awarded to Robert C. Storrie & Co. for the estimated sum of $3,372,000, which closely approximates the City Engineer's estimate. Work was begun on both ends simultaneously on November 30, 1914.

Already 1,600 lineal feet have been excavated westerly from the east portal, and 1,000 lineal feet of concrete tunnel lining have been poured. A short distance from the portal, a large underground station has been provided for the accommodation of passengers transferring from subway to surface cars and vice versa.

Excavation for the first 1,300 feet of tunnel and for the underground station, was performed in open cuts with steam shovels. A few hundred feet from the portal, the cut was so deep that it was necessary to remove material in two stages. One shovel first excavated to a depth of about 12 feet and discharged material into auto trucks on the bank above the excavation. Behind this, a second steam shovel completed the cut to the required depth and surplus was removed by auto trucks which followed up the steam shovel through the cut.

Most of the material through which the excavation was made stood without hanging; but near the corner of Eighteenth and Hattie Streets a deep, artificial fill extended across the line of the work. In this location it was necessary to

drive piles 50 feet in length on each side of the trench before excavation and brace across the excavation with 12x 12 inch spreaders.

In the same location it was necessary to carry the Eighteenth Street car tracks of the United Railroads across the open cut without interrupting service. Piles were then driven at 4 feet centers along the sides of the proposed excavation. There were then capped by 12 x 12 inch timbers and 14 x 14 inch beams placed upon the caps, so that they formed a solid decking under the railway and street. Girders were placed on top of the deck under each of the four rails.

The Eureka Valley Station is a steel beam structure, with 300 foot platforms to accommodate four-car trains. The steel and concrete work has already been completed and the forms removed.

Between this station and the portal is a curve with a radius of 716.78 feet. Forms for the curve were built in 8 foot chords, of ⅞ x 6 inch dressed tongue and groove, with 2 x 6 inch vertical ribs. When the concrete had set and the forms were stripped, the inner surface was entirely satisfactory. The use as a water-proofing agent of 8 pounds hydrate of lime to every 100 pounds of cement, gave to the finished concrete a smooth, dense surface so that little plastering was required.

The concrete at the east end is mixed in a one yard mixer, Niles sand and beach sand being used for the aggregate. Concreting work has been done very expeditiously, over 360 yards being an average 8 hour run. Considering that after mixing, this has to be wheeled for several hundred feet in buggies, the performance is considered a creditable one.

At the west end, 810 lineal feet of excavation and over 500 lineal feet of concrete lining have been completed. Over half of the work so far completed at the westerly end has been done in open cut. Concrete is deposited through a shaft leading to the horizontal ventilating chamber immediately above the tunnel. It is then wheeled through this chamber to the headings and packed by hand in the forms.

The method of timbering is shown in the accompanying diagram. Three drifts are first driven and timbered. Earth is then stoped out between the drifts and the 12 x 12 inch crown timbers set on 14 x 14 inch base plates. Next, 12 x 12 inch plumb bars are placed along the sides, and the core removed.

The material that the tunnel now traverses at the west end is a heavy packed sand and it is therefore necessary to place a solid lining through this excavation.

Excavation for the Laguna Honda Station is sixty per cent complete. The floor of this structure will be only 62 feet below the ground surface, so it was deemed most economical to excavate for the entire station from the surface in open cut. The material at this location is a well compacted sand. Piles were driven with a jet along the sides of the cut, to hold the banks in place. It is probable that the construction of the tunnel will be advanced in both directions from Laguna Honda Station.

On the surface directly above the Laguna Honda Station, a reinforced concrete building 100 feet in length will be erected to serve as a surface station. Three elevators, each with a capacity to provide for 50 passengers, will operate between the uodnrground and surface station. The exit elevators will connect directly with the station platform floor, and while on the return down trips, they will discharge incoming passengers on a deck 15 feet above the platform which will lead across the station to a landing from which by two flights of stairway the train platform will be reached. Considering the limited amount of business tributary to this station, this office feels gratified after a thorough study, in having reached such a satisfactory solution of this problem. As soon as the excavation is to grade, the steel and concrete in the station structure will be placed and the elevator shafts completed, in order that they may be used during construction as service shafts for the tunnel work.

Plans call for the construction of a ventilating shaft west of the center of the tunnel. This has been sunk to a depth of 30 feet, and when complete will probably also be used as a temporary construction shaft.

Funds for the tunnel construction are being provided by district assessment. The majority of the assessments are being paid in ten annual installments with interest on deferred payments at the rate of 7 per cent.

STOCKTON STREET TUNNEL.

On April 11, 1913, a contract was let to the Jacobsen-Bede Company for the construction of a tunnel in Stockton Street, extending from Bush Street to a point 182 feet south of the center line of Sacramento Street. Work was begun several months later and was delayed by interference through the tardiness of various property owners who had encroached on the sidewalk space.

The length of the compelted tunnel is 911 feet from portal to portal, with an approach 138 feet long on the north and 275 feet on the south. The arch is oval-shaped and the width at the springing lines is 50 feet in the clear. Of this width, 36 feet is occupied by the roadway, in the center of which tracks for the Municipal Railroad have been laid. A sidewalk 6 feet 6 inches wide accommodates pedestrians on either side of the tunnel. The height of the arch above the curb is 18 feet in the clear.

Funds for the work were obtained by assessment of the property benefited. The proportionate amounts chargeable to each portion of lands within the assessment districts were determined by appraisers working under the direction of the City Engineer's office. The tax per square foot varied according to the area of the parcel assessed, its proximity to the portal, the direction of traffic and whatever other local conditions tended to influence its probable increase of value.

During the fiscal year 1914-15, the Stockton Street Tunnel has been completed. This structure at the time it was designed, had the widest span of any street traffic tunnel ever undertaken. Its purpose is to overcome the steep hill which has long stood as a barrier to street railway, vehicular and pedestrain traffic, and to open up a direct line of communication between the North Beach District and the downtown retail area, and provide a route for the Municipal Railway.

The original plans for the tunnel, designed under the direction of my predecessor in the office of the City Engineer, specified a thickness of 1 foot 6 inches at the crown and 8 feet at the springing lines of the arch. Only one cross-section was designed, to be used throughout the entire length of the tunnel, because it was thought at the time the plans and specifications were prepared, that the material to be excavated was all rock.

When actual construction was under way, it was evident that some of the material traversed was too unstable to be supported with safety by the concrete arch as originally designed. Alterations in the cross-section were forthwith made. The thickness of the lining at the crown was increased from 1 foot 6 inches to 2 feet 8 inches, and a corresponding increase was made at the springing lines. This heavier section was used throughout almost the entire length of the tunnel.

By the construction of the Stockton Street Tunnel, the running time for street cars from Stockton and Market Streets to the entrance of the Panama-Pacific Exposition, has been materially reduced. Access has been provided to a part of the City that has great possibilities as a manufacturing district. Traffic through the tunnel is very heavy, and proves that the expenditure for this improvement was fully warranted.

SEWER SYSTEM.

San Francisco's sewer construction, for which bonds were issued in 1904 and 1908, was advanced almost to completion during the fiscal year 1914-15.

The principal work has been done in the western drainage area. Storm runoff from the Ingleside, Sunset and Richmond Districts is now carried to an outfall opposite Mile Rock, while domestic sewage is pumped out of the main conduit at 48th Avenue and Fulton Street; thence through a cast iron pressure sewer and finally discharged at Baker's Beach into the swift ebb current that flows through the Golden Gate.

MILE ROCK TUNNEL.

North of the Fulton Street Pumping Station the storm water outfall is in tunnel for a distance of 4,450 feet, extending from Cabrillo Street under Sutro Heights to the outfall on the sea front.

This tunnel is 9 feet in height and 11 feet wide, and traverses a soft sandstone and blue shale formation. Construction was handled from two adits, 3,116 feet apart, one at 90 degrees, the other at 20 degrees, with the center line. Through both of these, excavated material was removed in ¾ yard narrow gauge muck cars with mule traction and deposited in well compacted fill near the shore line, above the influence of high water. Two piston drills were used in the north heading where the formation was hard, and hand drills were found efficient in the softer formation through which the south heading was advanced. In this soft material 30 pounds of 40 per cent dynamite was used for each charge, while in the north heading the 18 holes 6 feet deep drilled during each shift, required an average of 60 pounds.

For timbering, two-post, five-segment arches of 8 x 8 inch timbers spaced at 5 foot centers were sufficient for most of the distance. Lagging was used only in heavy ground. For placing the concrete lining, the MacMichael Pneumatic System was used for the first time in this City successfully. Concrete materials were placed in ¼ cubic yard batches, discharged into a hopper and then forced by compressed air with necessary mixing water into the distributing pipe, through which it was conveyed to the forms. An average of 32 batches of concrete per hour were placed when the distance from the mixer to the point of discharge was as great as 2,000 feet.

Great accuracy was obtained in the alignment and grades of this tunnel. The two headings met with less than ¼ inch error.

As already stated, only storm water will flow through the Mile Rock Tunnel, as it is not desirable to discharge undiluted domestic sewage where there would be the least possibility of its being washed back on the ocean shore.

Contract for the Mile Rock Tunel was awarded on February 11, 1914, for the estimated sum of $193,314. On June 30, 1914, the estimated value of work completed was $2,296.80 and $1,122.30 had been paid contractor, who was unable to complete the work in accordance with the contract, and the Commonwealth Bonding & Casualty Insurance Co., a corporation, a surety on the bond of the contractor, took charge of the work. The Board of Public Works authorized R. C. Storrie & Co. to complete the tunnel on behalf of the Commonwealth Bonding & Casualty Insurance Co. On June 30, 1915, the entire contract was 70% completed.

FORTY-EIGHT AVENUE AND FULTON STREET SEWAGE PUMPING STATION.

To intercept domestic sewage from the main outfall conduit, a sewage pumping station has been constructed near the main sewer at 48th Avenue and Fulton Street. The pumps have been installed in a reinforced concrete vault beneath the street. This vault is 16 x 24½ feet in plan and 37 feet 7 inches high in the clear. The station is arranged in two separate units. Each unit consists of two 10-inch centrifugal pumps operated by a 200 h.p. vertical motor at a speed of 85 r.p.m. A 16 inch venturi meter is attached to the separate units. The total capacity of each unit is 2,000 gallons per minute.

From this station, sewage is pumped through a 24 inch bell and spigot cast iron pipe against a static head of 146 feet, a distance of 6,730 feet along Fulton Street to Twenty-third Avenue, whence it will flow to the Bakers Beach Outfall.

Contract for the construction of this station was awarded on June 3, 1914, to the Davis-Rogers Co. for the estimated sum of $6,980. The City took over the work of completing the station on April 1, 1915, the contractor being unable to complete the contract. The estimated value of the work finished on that date, including $1,065.43 for extra work, was $8,023.04, and the sum paid the contractor was $4,951.93.

Under the direction of the Board of Public Works the work was practically completed by June 30, 1915.

BAKERS BEACH SEWER.

To lay a cast iron submarine pipe in calm water does not present any unusual engineering difficulties. To perform the same work through a heavy surf, under such adverse conditions as prevail at Bakers Beach near the entrance to the harbor, demands ingenuity. The Bakers Beach Outfall is an 18 inch, cast iron, flexible joint sewer pipe, which extends 800 feet from the shore line and will have a discharge chamber 32 feet below mean low tide.

On account of the difficulties incident to laying the submarine pipe at the location specified, the City Engineer allowed the contractor to try several methods, only insisting that the finished line and outfall absolutely conform to the specifications. Several attempts were made by the contractor to accomplish this work before a successful method was finally adopted. First, an attempt was made to lay this pipe in a straight line just above the high-tide mark and parallel to the water's edge, pour and calk the joints, seal the two ends, buoy the whole line, float it into its position at right angles to the shore and then remove the buoy and allow the pipe to settle to its final position.

For this purpose, 8 x 8 inch timbers 50 feet in length, spaced at intervals of 24 feet, were laid at right angles to the water line, to serve as skids. On each skid an 8 x 8 x 30 inch cradle runner was placed, the 18 inch ball and socket joint pipe laid over these, and the joints poured and calked. The skids extended shoreward from the average high-water mark, the intention being to lay the pipe well above the highest high tide. Due to an existing pipe that terminated half way between mean high tide and extreme high tide marks, it was impossible for the first attempt, to lay the pipe as far inland as was desirable to avoid interference from unusually high tides.

When all the joints had been thoroughly calked, a "straight-back" made up of 6 x 8 inch timbers, was laid along the top of the pipe and securely attached to it with No. 8 wire. This "straight-back" was securely stiffened where the timbers joined, so that it would hold the pipe in a straight line while it was being floated into place. Sixty-two 12-foot pipe lengths, or a total of 744 lineal feet, were thus secured.

The weight of each length of pipe was approximately 2,100 pounds, and its displacement when submerged would be 24 cubic feet. Hence, since the line was sealed, a buoyant force of only 900 pounds per pipe length was necessary to prevent submersion. Four oil barrels, each with a capacity of 60 gallons, or a displacement submerged of 8 cubic feet, were attached to each pipe furnishing an additional buoyant force of 2,000 pounds per length.

Board covers 30 inches square and 2 inches thick were used to seal the ends. Both of these were securely fastened to flange collars around the pipe by four ¾ inch bolts. Between the board cover and the pipe ends, cardboard gaskets were inserted to insure against leakage.

For the reason previously stated, the pipe was first laid close to the mean high-water mark. On the evening of December 30, 1914, when almost all preparations for launching were complete, a severe storm, accompanied by an unusually high tide, moved the pipe from its original position into the curves

shown in one of the photographs. It was then decided that a better method than first laying the pipe parallel to the shore line would be to lay it in short sections perpendicular thereto. The following method was therefore tried.

By burning out the lead in every fourth joint, the pipe previously laid and calked as described, was separated into sections, each 48 feet long and made up of four pipe lengths. A skidway 24 inches was built from shore to beyond the first line of breakers and a platform consisting of five 8 x 8 inch runways was erected adjoining the skidway. The 48 foot sections of pipe were placed on this platform so that they could be rolled in rapid succession onto dollies, that would carry them down the skids. The three joints in each 48 foot section were recalked while the pipe was on the platform.

A barge was anchored 800 feet from shore, and a hand winch set up on the barge. The intention was to pull a 48 foot section far enough out on the skidway to allow the next section to be rolled in line behind it. The joint was then rapidly poured and calked, and four sealed empty barrels wired to each pipe length to buoy up the line.

When the two 48 foot sections were joined and the barrels attached, the winch on the barge was operated and the pipe pulled 48 feet seaward. The above operation was then repeated. Anchors, all equipped with block and tackle, were placed in two lines, each line 50 feet from the proposed center line of the pipe. As the pipe was pulled seaward, lines from the anchors were fastened and kept taut to hold it in the proper position.

June 5th was chosen as a suitable day for launching the pipe in the above manner, as all indications on the day before looked favorable for a calm sea and a little wind. Accordingly, work was begun on the morning of that date and all went successfully until 240 feet of pipe had been floated to sea. With the turning of the tide, a strong breeze set in through the Golden Gate and heavy swells began to break on the beach, greatly impeding the work. Finally, a particularly high breaker swept the pipe off the skids, stove in many of the barrels and the half-laid line sank gradually to the bottom.

It was then determined that the only safe method of laying the pipe would be to drive a pile trestle along the proposed line of the sewer, laying the pipe thereon and lowering it as the laying progressed. The reason that this was not done originally was because during the winter and spring seasons the ocean in the vicinity is not calm enough for sufficiently long periods to permit of anchoring a pile driver along the line of the sewer.

On June 30, 1915, half the trestle was constructed, and the work progressing satisfactorily.

VISITACION VALLEY SEWER.

A contract was awarded to Gorrill Bros. on October 2, 1913, for the construction of 15 inch, 18 inch and 21 inch ironstone pipe sewer in Rutland Street from Harkness Street to Campbell Street, of 2 feet by 3 feet and 2 feet 6 inches by 3 feet 9 inches reinforced concrete sewer in Rutland Street from Campbell Street to Sunnyvale Avenue, and for the construction of reinforced concrete sewer varying in dimensions from 2 feet by 3 feet to 6 feet 6 inches circular, from the corner of Schwerin Street and Sunnydale Avenue to San Francisco Bay. Of the 6 foot 6 inch circular sewer, 1350 lineal feet are in tunnel.

At the beginning of the past fiscal year, 80 per cent of the contract had been completed. During the past fiscal year the work was satisfactorily completed and was accepted on October 30, 1914. A total of $105,797.01 was paid to the contractor.

AUXILIARY WATER SUPPLY SYSTEM FOR FIRE PROTECTION.

During the fiscal year 1914-15, the principal work on the fire protection system was the construction and equipment of the Central Fire Alarm Station, and portions of the new fire alarm system.

Most of the underground work on the alarm system was completed previous to July 1, 1914. Wherever possible, cables were laid in vacant existing ducts. On many streets, however, it was necessary for the City to lay its own conduits. These were installed in the same trenches and at the same time as the high pressure pipes.

Ducts were of creosoted wood, 4½ x 4½ inch square, with 1½ inch creosoted cover planks. Both single and multiple duct conduits were laid, depending on the number of cables to be provided for. In each block they terminated at valve vaults or vaults of either of the operating telephone companies. In laying the ducts, before driving the tenon into the mortise, it was thoroughly painted with asphalt and then driven completely home, in order to secure a watertight joint. Multiple ducts were laid so as to break joints both horizontally and vertically, and collars of 1½ x 4½ inch creosoted plank, spaced at 6-inch intervals, hold them together. Upon the completion of each block, a mandrel 3 feet in length and one-quarter inch smaller in diameter than the normal size of the duct, was drawn from manhole to manhole. Ducts through which this could not be drawn were taken up and relaid by the contractor at his own expense.

The central fire alarm station is situated in Jefferson Square, at the intersection of Turk and Octavia Streets.

Especial care was taken to provide a location for this building which would be as nearly as possible free from fire hazard; and to accomplish this purpose the center of a protected park was selected. All material incorporated in the station is absolutely fireproof, no wood whatever having been used in its construction. Further, no gas was brought into any portion of the structure where an explosion could cause damage to the fire alarm equipment. Hot water heat is provided by a gas heater, but this appliance, together with a gasoline-engine driven generator, is separated from the rest of the building by a 10 inch reinforced concrete wall.

All alarms from street boxes are received at the central station on telegraph sounders and registers. The street boxes are arranged to sound in their number four times. After receipt of the number twice, the operator attending the box circuit calls the number of the box to the operator, whose duty it is to send the alarm to the engine house. He in turn transmits the number four times; twice over a tapper circuit and twice over a gong circuit. The tapper circuit is arranged for quick action and sends a practically still alarm, which is received at the engine house on a small bell. The gong circuit confirms the information transmitted over the tapper fire. This arrangement of operation is known as the manual system, no provision being made for the transmission of alarms directly from fire alarm boxes to engine houses.

The central station switchboard comprises 11 panels. All are not equipped at the present time as provision has been made for growth. The switchboard proper is 102 feet in length, and when fully equipped will handle 88 box or signal circuits, 16 alarm and 16 joker circuits, together with hospital panel for 12 signal circuits, 2 tapper circuits, 2 alarm circuits and 2 joker circuits. The hospital service provides for the transfer of any circuit from its regular position in the board to a separate panel, where it will be supplied with the necessary current from a motor generator set, one such machine being supplied for each hospital circuit. In this way, grounded or crossed lines can be entirely isolated and connected to a panel provided with special equipment for the treatment and operation of crippled lines.

The source of power is a storage battery of 280-ampere-hour capacity. From this battery are driven dynamotors through which power is furnished to the various circuits. Current for four lines is taken from each dynamotor. This arrangement was made in order to insulate the lines from each other and the battery from the ground.

Particular care has been taken in laying out the device for charging the storage battery. Provision has been made to charge it from the direct current mains or the alternating current mains of the two different companies. Further safety has been secured by the installation of a gasoline-engine driven generator, which, in emergency cases, can be used to supply current for the battery and lights for the building.

STREETS, ROADS AND BOULEVARDS.

We have but to look at some of the steep hillside grades of San Francisco to realize that no great amount of study was originally given to the proper planning of our street system. The engineer who laid out the City originally, with entire disregard to topography, drew two straight lines at right angles, one supposedly north and south, the other east and west. Parallel to these, he penciled the street lines of what was later to be the great metropolis of the Pacific Coast. As the City expanded, his idea was followed with few variations until recent years. San Francisco therefore, regardless of topographical obstacles, like nearly every other large American city, expanded along straight lines. While this may be desirable in level business districts on many of our hills, which are admirably adapted to fine residence sites, property values are very low, because suitable approaching grades and contour streets were not provided. Present practice in constructing streets and roads in the residential districts contrast strongly with the above tendency.

Topographically, the peninsula of San Francisco offers unequaled opportunities for the development of scenic boulevards, whether it be over rolling hilly country, through forests, along the bay shore, around the precipitous cliffs, along the Golden Gate, or skirting the shore of the Pacific Ocean.

These unrivaled sites remained practically undeveloped until recently, when through a progressive municipal government, two of these boulevards have actually been built, three are in course of construction, and plans have been adopted and funds set aside for others. These boulevards are enumerated as follows:

No. 1. Junipero Serra Boulevard..... (Finished.)
No. 2. Sloat Boulevard ..... (Finished.)
No. 3. Portola Drive ..... (75% finished.)
No. 4. Market St. Extension (Corbet Ave. plan No. 1)..... (Proposed.)
No. 5. Market St. Extension (Plan No. 2)..... (Proposed.)
No. 6. 19th Ave. Boulevard..... (Partially completed.)
No. 7. Ocean Boulevard ..... (Partially completed.)
No. 8. San Bruno Ave. "Extension"..... (Partially completed.)
No. 9. The Great Highway and Esplanade..... (Proposed improvement of.)

The construction of the Junipero Serra Boulevard was the first work to be undertaken under the comprehensive development plan recently adopted. This was previously a macadam roadway 25 feet in width with a very high crown dangerously low on the sides, and many portions were in a more or less disintegrated condition. The road followed the natural undulating surface of the ground.

In reconstruction, the first step after the completion of the survey was to correct the existing grade by eliminating sharp verticals and introducing in their place long and smoothe curves. The grade was straightened as far as possible without making heavy cuts or fills which were prohibitive, as the amount of money available for this reconstruction was very limited.

The paved portion of the roadway is 25 feet in width with 5 feet rock shoulders on either side and slopes on fill of 1½ on 1. Gutters are 5 feet wide and 22 inches deep. At stated intervals, concrete culverts provide for the diversion of storm water. A flat crown was adopted for reasons already explained, and because the longitudinal grade amply provides for drainage.

The base is of standard cement concrete, 6 inches thick, with the sides raised to 8½ inches and made 6 inches wide, so as to inclose the asphalt pavement on top as depressed curbs and prevent creeping. The concrete is covered with asphaltic binder 1½ inches thick, and over this is a 1 inch asphaltic wearing surface. The thickness of this pavement is much greater than any recommended or constructed by the State Highway Commission, and in durability and excellence it will be superior to any of the state highways.

Another link in the chain of boulevards was added by the construction of the Sloat Boulevard from Junipera Serra Boulevard to the waters of the Pacific, where it connects with the Great Highway, an oiled macadam road. Apart from the advantage of location, the great highway has nothing to commend in the way of ease of traction or regularity of outline. It will shortly be replaced by an esplanade, now under study in this Bureau.

Sloat Boulevard:

The portion of Sloat Boulevard, which has just been completed, gives to the motorist a modern asphalt pavement 30 feet in width and 2.16 miles in length. This strip was designed as part of a proposed boulevard 135 feet in width, with a double track electric railroad in the center. The tracks occupy a 35 foot right of way, 10 foot walks being provided on either side of the outside rails and 2 foot concrete gutters adjoining. The intention is to make this a two-way traffic boulevard, divided by the railroad tracks, to insure the greatest safety to the traveling public. To carry this project to final success, it will be necessary to move the United Railroad tracks southerly to the center of the proposed roadway.

The section improved has a straightway stretch of 1.4 miles, upon which the view is unobstructed. A reverse curve, the east portion of which is on a fill, is protected by a two-rail wooden fence similar in design to that adopted as standard by the California Highway Commission.

Sloat Boulevard, as originally constructed, was 70 feet in width, with a 35 foot railroad right of way to the north, leaving a net available width of roadway of 35 feet. This was of oiled macadam just prior to the building of the new 135 foot boulevard, of which only a 30 foot strip could be built at this time. It was thought advisable to use the grade of the old road as nearly as practicable, easing off and lengthening the vertical curves and correcting all irregularities. The policy was to save as much as possible of the old base of the oiled macadam road, which had become thoroughly compacted by years of travel, as a foundation for the new road. When the necessary property has been obtained on the northerly side of the boulevard for its widening, the contemplated improvement can be made in its entirety, and will result in giving to the City as fine an automobile boulevard as can be economically constructed.

Portola Drive:

Near the east end of the Sloat Boulevard above mentioned, is the Portola Drive, the third link in the City's Boulevard System. Its lowest point is at an elevation of 260 feet above city datum, and its highest at an elevation of 586 feet. It has armored concrete curbs throughout with storm water inlets at the various street intersections along its length. The City has paid the cost for paving a 20 foot strip throughout. The remainder is paid for by the property owners along the route. The crown is 5 inches, the base is of 6 inch concrete, the asphalt binder course 1½ inches thick, and the asphaltic surface coat 1 inch thick. This drive is a series of long and easy curves. It adjoins some of the finest residential tracts in the City, such as St. Francis Wood and Clare-

mont Court. Along its line are two of the highest points in San Francisco, namely Mt. Davidson and the Twin Peaks, while close to its westerly end lies the west portal of the Twin Peaks Tunnel. On June 30, 1915, the contract for its construction had been completed.

Market Street Extension (Proposed).

Plan No. 1. Commencing at the present northerly termination of Portola Drive, where it meets the westerly boundary line of the Stanford Heights Tract, an extension to this drive is planned. This extension, which will be known as Corbett Avenue, is a portion of the proposed plan for the extension of Market Street under what is known as Plan No. 1. It is proposed to build it to 24th Street where it will join with the remaining portion of the Market Street extension and continue on to Market Street at 17th Street. Rights of way from adjacent property owners are now being procured to make this road of an uniform width of 70 feet, rounding out the irregular widths and angular features of the old road and developing an attractive boulevard. This section to be built under Plan No. 1 will consist of an asphaltic pavement .87+ miles in length and 25 feet in width. The base will be of concrete 6 inches in thickness, the asphaltic binder course 1½ inches thick, and the asphaltic surface coat 1 inch thick. A 5 foot shoulder on the inner side, a 3 foot concrete gutter, and an armored concrete curb completes the cross section of the road as planned. The average grade will be somewhat less than 5 per cent and the maximum grade, 7.5 per cent. The highest point reached by this stretch of road will be at elevation 591, and the lowest at 511 feet above City datum. This will be exceeded in height by only one other proposed boulevard, namely the scenic drive that is planned to go around Twin Peaks mountain and reservoir.

Plan No. 2. Beginning at 24th Street and joining with the section proposed under Plan No. 1, a second and final section of the Market extension is planned. This, in its upper reaches, will follow a winding course around the hills and connect with the present Twin Peaks Tunnel Right of Way near Hattie and 18th Streets and follow over the tunnel to Market and 17th Streets by an easy grade route at its extreme easterly end, close to the east portal of the Twin Peaks Tunnel. It is expected that when this link is completed, being a direct surface extension of Market Street, this will be one of the most popular of the scenic boulevards in the City, affording, as it will, an unsurpassed view of San Francisco, the Bay, the Bay Cities and portion of the Golden Gate Straits. On the other side of the Ridge, one will pass through stretches of forest, getting an occasional view through the clearings, of the Pacific Ocean to the west.

19th Avenue Boulevard.

19th Avenue Boulevard, one of the oldest oiled macadam roadways in the City, is now under reconstruction for the greatest portion of its length. One contract has already been completed, comprising a stretch of asphalt pavement 40 feet in width and 4,000 feet long. There is also being paved a stretch 3,320 feet in length and proceedings are under way to finish the paving of the entire boulevard, which is a little over 2 miles long. This roadway runs almost due north and south and connects the Sloat Boulevard and Lincoln Way, passing through the Sunset District, one of the largest residential areas in the City. The specifications for the paving are similar to those for other boulevards already described. The estimated cost of the two contracts above mentioned is $71,940.65. The 19th Avenue Boulevard will be the shortest route for motorists who wish to journey down the Peninsula to San Mateo and other suburban points.

Ocean Boulevard.

The marine view boulevard planned for the north shore line and to be paid for by the Panama Pacific International Exposition Co., the United States Government and the owners of adjacent property, is now under construction. Although the alignment has been somewhat changed, the general plan proposed by the City Engineer in 1913 has been adopted. The route connects the Exposition grounds with the ocean beach, following the meanders of the bay shore, passing through the Presidio Reservation by way of Fort Winfield Scott, along Bakers Beach near West Clay Street to Lincoln Park, and through Lincoln Park by way of Fort Miley Military Reservation to the Cliff House; thence to the Ocean Boulevard. The portion between Lincoln Park and the Presidio, 3,200 feet long and 80 feet wide, will be paved with asphalt and completed by the last of September. The portion through Lincoln Park, a macadam road, has been practically completed by the Park Commission. The Government's portion will be contracted for as soon as adequate funds are appropriated by Congress through the efforts of Senator Phelan and Congressman Kahn and Nolan. The intermediate section is being constructed under direction of the City Engineer and will be paid for with funds provided by the Panama Pacific International Exposition Co., and will be completed by August 31.

San Bruno Avenue Extension.

Contracts have been let for the grading and paving of almost the entire unfinished portion of San Bruno Avenue. When completed, this roadway will extend to the County Line where it will join the recently completed Bay Shore Boulevard of San Mateo County. This will become a very popular roadway, as it will afford egress from the eastern portion of the City, just as Mission Street affords a middle route and the Junipero Serra Boulevard a western exit, down the Peninsula. As the old location of San Bruno Road southerly into Visitacion Valley had excessively steep grades (12 per cent), a study was made of an improved route by deflecting easterly through the Crocker Estate lands for a distance of 3,000 feet. By this means, a 5 per cent grade was obtained and a streetway 80 feet wide secured, which will assure for all time an easy route to meet the San Mateo boulevards. The City should feel under obligations to the Crocker Estate for their generous attitude in donating this route through lands they had already surveyed, platted and improved.

The Esplanade.

With the assurance of an appropriation of $50,000 by the Supervisors, the initial work on the proposed esplanade along the ocean beach south of the Cliff House will soon be inaugurated, and in time, the present antiquated and irregular though scientifically beautiful Great Highway, will be superseded by one of the most popular and elaborate boulevards in the entire system. Plans are now being prepared in this office for the proposed esplanade. The study of a plan that will survive the inroads of the sea and harmonize with the uses and improvements of the Park and Beach, is being considered.

Bernal Cut.

The project for improving the Bernal Cut by opening a new thoroughfare 90 feet wide, parallel with Mission Street, has been studied in the City Engineer's office and plans and estimates for completing this work have been transmitted to the Board of Public Works.

When funds are provided by the Board of Supervisors, the new street will be constructed from the intersection of Dolores, Mission and Randall Streets; thence passing through the old Bernal Cut, parallel to the Southern Pacific Tracks, to a junction with San Jose Avenue near Sunnyside Avenue and Diamond Street, a distance of 4,642 feet. Owing to the steepness of the excavation, it is contemplated to build two retaining walls of concrete 40 feet high, one on each side of the cut, with a clear space of 90 feet between the walls. Provision is also made for the necessary bridges to carry Miguel Street and Charles Street across the proposed cut. The alignment of the present bridge on Charles Street

will have to be altered so that a direct entry can be made to Arlington Street, to which access is now impossible from the existing bridge. This readjustment will give additional value to the project.

One side of the cut will be used for the double tracks of the Southern Pacific Company, which will occupy 29 feet, and the remainder will be devoted to a paved roadway 52 feet in width and a sidewalk 8 feet wide. The entire width to be occupied by the roadway, the tracks of the Southern Pacific Company, and the base of the retaining walls will be 120 feet. The Southern Pacific Company owns a right of way 100 feet wide through the entire cut and in the City's concession granting a franchise for a new Third Street Depot, it was agreed by the Company that it would release such portion of its lands and make the necessary excavations through the Bernal Cut for road purposes as it did not need for its tracks.

In order to secure an entrance to the Cut and avoid the steep grades of Mission Street, which are as high as 7 per cent, it will be necessary to extend the easterly line of Dolores Street southerly to Randall Street, secure a triangular strip of land therefor about 100 feet long by 40 feet in width, and to take an additional strip of Randall Street for a distance of 240 feet. The grade of the proposed road will not exceed 3 per cent, which will be a great advantage for teaming, hauling and auto trucks, as against the 7 per cent grade of Mission Street and the steep incline which has to be made now to surmount the old St. Mary's College hill. The new route will cut off a climb of 60 feet necessary to pass over the present Mission Street hill.

While the entire cost of the project will aggregate $585,000, this is not excessive for procuring a level roadway 52 feet wide where such a road is badly needed. The price includes all lands necessary to be acquired, damages to buildings, cost of grading, cost of paving, damages to improvements and other incidental expenses. This work has been demanded by the Improvement Clubs in the southern end of the City, and the plans and estimates have been made at their request.

MUNICIPAL RAILWAYS.

Since San Francisco took the first step toward the actual ownership and operation of a street railway system in July, 1910, when $2,200,000 of bonds were voted for the construction of the Geary Street Railway from the Ferries to the Ocean, the City has acquired, constructed and equipped 42.75 miles of single track, and has under immediate contemplation the construction of some 6 miles additional, including the Church Street Line and an extension to the Geary Street System from Tenth Avenue and Fulton Street across Golden Gate Park into the Sunset District.

Of the 42.75 miles of track at present in operation, approximately twenty (20) miles have been completely constructed during the last year, when the City developed a record by building and equipping that amount of road, and demonstrated that with unity of purpose and co-operation of the citizens and departments of the City government, a municipality can secure results in rapidity and economy of construction equal to the best organized private companies operating public utilities.

The Municipal Railway System from an operating standpoint, has been an unqualified success from the beginning. The receipts have daily increased from the time that the first Geary Street car was placed in operation, up to the present. The steady increase of receipts of the Geary Street line previous to the opening of the Fair, has been due to the maintenance of splendid service with well designed cars operated at frequent intervals, and a relatively high average rate of travel made possible by an exceptionally well constructed roadbed, and to adequate motor equipment. The motors installed enable the cars to start

quickly and to maintain the normal speed on heavy grades. This is a more effective method of operation and safer than to raise the speed inordinately on level or down grade stretches.

With the opening of the Fair and the completion of the additional lines, increased receipts from the system have been very marked. On the opening day, February 20, the maximum receipts were recorded. On this date, over $13,000 was received in fares which indicates that in a single day the municipal lines carried some 260,000 passengers exclusive of those carried on transfers, and that one-half the Exposition attendance on that day rode both ways on Municipal cars. The average daily receipts at the present time are approximately $6,200, which means a daily haul of 124,000 passengers exclusive of those carried on transfers. It is interesting to note that the daily receipts for June, compared with those of April, show an increase of 8,000 passengers handled daily, and the indications are that these will still further be increased during the remaining months of the Exposition.

Later, as soon as the revenues warrant, and other districts need service and transportation, additional extensions will be made. It is the intention to provide San Francisco with street railway transportation facilities second to none. Nothing that can be done by the City Administration will prove a more potent factor in providing for the numerical and commercial expansion of San Francisco.

During the campaign which preceded the authorization of bonds for extensions to the Municipal Railways, the City Engineer promised the voters that, if the proposed bond issue was authorized he would have all of the proposed roads, with the exception of the line on Church Street, in operation prior to January 1, 1915. As the bond election took place on August 26, 1913, this allowed only sixteen (16) months and four (4) days in which to complete the work, which involved an expenditure of $3,500,000.

Previous to the election, inquiries had been instituted among the manufacturers of the required materials, as to how rapidly delivery could be made. By referring to the records of previous performances in the construction of the Geary Street road, it was possible to determine the time which would be required to build the roadbeds and electric construction. A program was then made out showing the dates upon which it would be necessary to place contracts for the delivery of the material and for construction, in order to have the various roads completed in the time promised. This program contemplated the completion and placing in operation of the Van Ness Avenue and Chestnut Street line on September 1, 1914; it was placed in operation on the 15th of August, 1914. The Potrero Avenue line was to be placed in operation on October 1. The 7th of September saw the line completed and operating. The Columbus Avenue and Stockton Street line was to be finished on November 1. It was completed according to schedule, and regular operation was commenced on December 29, 1914. The California Street line was delayed by inability of the City Treasurer to dispose of bonds rapidly, due to the demoralization of the money market by the European war. The contract for its construction was awarded on December 14, 1914, and completed on March 28, 1915. Had the recommendations of the City Engineer been adopted without argument by the Board of Supervisors, the Church Street line would now be completed and, like the other units of the system, pouring money into the City's Treasury.

CAR BARNS.

On December 4, 1914, a contract was awarded to the Clinton Fireproofing Company for the construction of the first story of the Seventeenth Street Car Barn. This structure is designed for an ultimate capacity of 192 cars, and occupies an entires City block which was selected because of a twenty (20) foot

difference in level between the boundaries. This enables both floors of the building to be used with a minimum of cost for approaches. The lot is situated between Mariposa, Seventeenth, York and Hampshire Streets, and is 200 by 400 feet with areas under the sidewalks of York and Hampshire Streets 16 feet by 110 feet, in which are located toilets, locker rooms and shower baths for the men and a small work shop for taking care of minor repars to cars. The first story, as at present constructed, has a capacity of ninety (90) cars with track accommodations for ninety-six (96) cars, but owing to the requirements for temporary office room, one of the tracks is not yet available for the use of cars. An entrance to the first floor is on Mariposa Street. Branch-offs from the main line are installed on Potrero Avenue, which is one block distant from Hampshire Street. These branch-offs lead to a ladder track from which seven two-track groups enter the building, which is divided into seven bays.

Special work is all of solid manganese steel, purchased at a very slight excess cost over hard center work. Comparative bids were first received on both types of construction. Each one of these storage tracks will hold seven cars except the first and last, which hold six. Inspection pits are provided under all tracks for practically the entire length of the barn. The building is divided into three sections by two fire walls extending the entire length. A 50,000 gallon steel tank has been erected on steel supports over the center of the building for the purpose of fire protection in connection with an automatic sprinkler system which is to be installed.

The storage tracks on the second story of the building, which will be built to meet the necessities of future extensions of railway system, will be connected with the main line on Potrero Avenue by branch-offs at Seventeenth Street through a ladder track on the Seventeenth Street side of the barn.

The second story, when completed, will have the same capacity as the first story; namely—96 cars. Also inspection pits are provided throughout the length of the building, the floor of the pits being given a waterproof cement finish and serving for the present as a roof of the first story. The building, when ultimately completed, will have the administrative office quarters as a third story fronting on Seventeenth Street. The first story is constructed largely in excavation and is of necessity without windows, nevertheless, the use of artificial lights in the daytime is almost entirely unnecessary. The interior walls and ceiling are painted white above a five-foot base and distributes the light from the entrance and from some small floor skylights temporarily installed.

Due to delays in securing title to the property, the construction of this building could not be commenced until after all of the cars purchased for the Municipal Railways under the 1913 Bond Issue had been delivered, rendering it necessary to store some forty cars in the open on tracks in the vicinity of the Geary Street barn during the construction period. In order to expedite the completion of this barn and avoid delay, a bonus of $12,000 was provided in the contract, $8,000 of which the contractors could earn by advancing the completion of this first story to afford storage for forty cars within seventy days after signing the contract, the remaining $4,000 to be earned by completing the entire work within one hundred and forty days. Much credit is due to the contractors for the way in which they handled this work and earned the full bonus in both cases in spite of severe weather conditions. The contract price of the building was $196,900, and with the bonus $208,900.

Plans have been prepared for the addition of a second story to the Geary Street Car Barn. The addition will contain sixteen (16) offices for the operating department of the road, toilets, instruction room and store room. Proposals for this construction will be received by the Board of Public Works on July 28, 1915.

EXTENSIONS.

Bonds to the amount of $3,500,000 for extensions to the Municipal Railway System were authorized by a vote of 51,452 to 13,782 at a special election held in August, 1913. One of the contemplated extensions by which additional transportation would be provided to the densly populated Noe Valley District, was from Market Street and Van Ness Avenue to Church Street, thence along Church Street to Thirteenth Street.

Southward from its intersection with Eighteenth Street, Church Street ascends a 14.4 per cent grade for a distance of one block 520 feet in length. In the next block southward are ascending grades, 7.9 per cent for half the distance and 1.75 per cent for the remainder. From Twentieth to Twenty-first Streets is a 19.3 per cent ascent. Thence the descent is at the rate of 11.5 per cent for a distance of 520 feet to Twenty-second Street. As these grades are prohibitive for electric railway traffic, means of overcoming them were made the subject of a special study by the City Engineer.

Nine possible methods of solving the problem were submitted to the Board of Supervisors, together with a cost estimate of each. It was believed that a plan could thus be agreed on that would be acceptable to all of the property owners of the district, whose holdings would be affected by the proposed improvement.

The first plan submitted, contemplated the construction of a reinforced concrete viaduct from Dorland Street to Nineteenth Street, the raising of the grade on one-half the width of Church Street from Cumberland to Liberty Street, and lowering of the grade on one-half the width of Church Street from Liberty Street to Twenty-second Street. This would involve reinforced concrete walls to retain the cut and fill, as well as an additional cut on Twenty-first Street. The entire cost of this project was estimated at $210,000.

The second plan considered was a modification of the above, a tunnel with open cut approaches being substituted for the open cut at the crest of the hill. The cost was estimated at $230,000. Its advantage would be that the existing street grades at Twenty-first and Church Streets, to conform with which numerous homes near that corner were constructed, would not be destroyed. In both these plans the maximum grade for the proposed railway would be nine per cent. In Plan 1, however, the grade at the crest of the hill would be one per cent less than with the tunnel.

Plan 3 also contemplated a tunnel with open cut approaches at the crest of the hill, as in Plan 2, but instead of a viaduct a detour was to be made toward the east involving an open cut with side retaining walls through the westerly side of Mission Park, as shown in Fig. 3. Nineteenth Street would be carried across the cut by a bridge. The cost of this project would be the same as for Plan 2, namely $230,000.

Plan 4 contemplated two detours, one between Eighteenth and Twentieth Streets, through Mission Park, as in Plan 3; another around the crest of the grade, as shown. Under this plan, it was intended to provide a boulevard seventy (70) feet in width for the entire distance from Eighteenth to Twenty-second Street. The center of the Boulevard was to be occupied by the Municipal Railway tracks, and the remainder retained for vehicular and pedestrian use. The necessary property between Twentieth and Twenty-second Streets would be acquired by condemnation proceedings. The cost of this project was to be divided between the City and a local assessment district, and was estimated at $330,000, of which $170,000 would be for real estate.

Several property owners opposed the above plan because they did not desire to pay any assessment. This project was therefore modified by narrowing the proposed right of way to 28 feet, omitting the boulevard feature, slightly readjusting the route and the City Railroad bearing the entire cost of right of way.

In this form, the project was finally approved by the Board of Supervisors. The cost is estimated at $200.000.

Besides the solution of the problem submitted by the City Engineer, several were proposed by outside parties. One of these was an auxiliary cable line over the hill, which would have been both dangerous and inefficient. Another proposal was to lower the crest of the hill 28 feet, thus reducing the approaching grades to a maximum of 11.6 per cent. Neither plan was considered desirable by the City Engineer, so both were abandoned after considerable useless and costly conflict before the Board of Supervisors.

Construction of the Church Street extension of the Municipal Railway will be undertaken as soon as the necessary property is acquired.

A terminal loop has been constructed at the Great Highway and Cabrillo Street for the Geary Street Road; an extension has been made to the Geary Street Car House, increasing its capacity from 60 to 134 cars; the installation of machine shop equipment has been completed; and additional underground cables have been installed to meet the demands of increased service. Foundations are being constructed for a water tank to be used in connection with a proposed sprinkler system.

On November 30, 1914, by Journal Resolution No. 1546 of the Board of Supervisors, the Board of Public Works was directed to prepare plans and submit an estimate of cost of the construction of an extension to the Municipal Railway from Tenth Avenue and Fulton Street across Golden Gate Park by the most feasible route to Judah Street.

In accordance therewith, a route has been selected and preliminary surveys made therefor extending across the Park from Tenth Avenue to Fourteenth Avenue, and thence to Judah Street. Through the Park a sinuous route is followed to the west of the Japanese Tea Garden and to the east of Stow Lake, and thence in a straight line from the South Drive to Fourteenth Avenue. There are no grade crossings except at a minor driveway midway between the South Drive and Lincoln Way. All other driveways and foot walks will be carried over the railway on architecturally attractive concrete viaducts, which will harmonize with the scheme of Park improvements. The amount of cut and fill is practically balanced, and the maximum grade is less than five per cent. The plans and specifications for this work are ninety per cent complete. It is worthy of note that this extension will be constructed entirely with funds derived from the surplus earnings of the roads already in operation.

ISLAIS CREEK INCINERATOR.

At the present time, garbage is collected in San Francisco by licensed scavenger wagons. Each scavenger arranges terms of service with the householder and disposes of the collected material to the Sanitary Reduction Works, paying sixty cents per ton for its disposal. The Sanitary Reduction Works, which operates under a 50 year franchise granted on February 26, 1896, had the exclusive right to destroy garbage within the City limits by the process of cremation. The franchise was granted for the sum of $2,510, and the further payment for 15 years of 2 per cent and for the remaining 35 years 5 per cent of the gross receipts.

When San Francisco decided to operate a municipal incinerator, it purchased the plant, including the real estate, of the Sanitary Reduction Works for $400,000. A contract was later awarded (in November, 1910) to the Destructor Company, a subsidiary of the Power Specialty Co. of New York, for the installation of two incinerating plants, each with a capacity of 120 tons in 24 hours. Under the terms of the specifications, the contractor guaranteed:

1. That no nuisance would be created in the normal operation of the plant.
2. That no odors, obnoxious smoke, or dust would escape from the chimney.

3. That, at no time during the normal operation of the plant, the temperature in the combustion chambers would fall below 1250° F., and that an average temperature therein of at least 1500° would be maintained.
4. That the residue from the furnaces would be thoroughly burned hard and free from organic matters.
5. That the flue dust collectors, furnaces, and combustion chambers would be so arranged that it would be unnecessary to shut down any one unit for more than 48 hours in any one week, in order thoroughly to remove dust and ashes.
6. That the pounds of refuse per hour which would be incinerated per square foot of grate area, should not be less than that stated in the contractor's bid (83⅓ lbs.).
7. That the average cost per ton of each plant for incinerating refuse would not be greater than stated in the contractor's bid (theoretical profit of 25.5 c. per ton).

Under the terms of the specifications, the contractor was to be allowed monthly payments on the incinerator equipments as it was manufactured. Evidently my predecessor, the City Engineer who then held office, had every faith in the ability of the contracting company to fulfill the terms of its agreement with the City, for under specifications prepared by him, the City's only recourse, if the plant proved unsatisfactory on completion, would be to sue for recovery of the payments already made.

In August, 1913, the installation of the furnaces and mechanical equipment had advanced to such an extent as to permit of commencing operations in order to train the operators and to discover any minor defects in the machinery, and accordingly arrangements were made with the scavengers to commence delivering mixed refuse and garbage at the Islais Creek Incinerator on August 28.

The plant was operated intermittently during the months of August, September, October, December, January and February, during which time a total of 2037 tons of mixed garbage and refuse was incinerated in the furnaces.

These preliminary operations demonstrated that the machinery and appliances which had been installed for the purpose of handling the clinker and ashes, did not meet the requirements of the specifications, and that modifications in the overhead traveling crane and other parts of the mechanical equipment were necessary.

After the required modifications, the final test was commenced on September 4, 1914, and completed October 3, 1914. The following tabulation shows the results of the test:

ANALYSIS OF SAN FRANCISCO REFUSE DURING INCINERATOR TEST.

Date 1914	Tone	Grab Buckets Hoisted	Samples Taken	Per Cent of Moisture	Per Cent of Combustible
September 23	121.61	181	22	55.9	25.9
September 24	92.13	132	22	43.1	24.9
September 25	104.21	150	25	56.5	23.4
September 26	109.92	143	24	52.9	26.5
September 28	113.94	162	27	55.4	26.5
September 29	134.39	188	30	47.7	23.9
September 30	138.40	180	30	52.5	25.7
October 1	110.85	156	25	48.9	28.0
October 2	104.45	123	20	48.6	27.3
				471.5	231.2
Average for 9 days				52.4	25.8

ANNUAL REPORT

OF THE

Bureau of Engineering

City and County of San Francisco

FOR THE

FISCAL YEAR ENDING JUNE 30, 1916

M. M. O'SHAUGHNESSY
CITY ENGINEER

Neal Publishing Co., 66 Fremont Street, San Francisco

REPORT OF BUREAU OF ENGINEERING

FISCAL YEAR 1915-1916

San Francisco, July 1, 1916.

To the Honorable, the Board of Public Works,
of the City and County of San Francisco.

Gentlemen:—Herewith is transmitted the annual report of the Bureau of Engineering for the fiscal year 1915-1916.

In accordance with the policy of developing an adequate boulevard system with the greatest commercial and scenic possibilities, much work has been expended in improving main avenues for vehicle traffic.

Railroad Avenue has been paved and graded so that when the new pavement shortly to be constructed on Third Street is completed, it will be possible to travel through the Industrial district on a smoothly paved boulevard 100 feet wide from Third and Market Streets to the County line.

Negotiations for the Hunter's Point road have been advanced and specifications prepared. This thoroughfare should be constructed during the coming year.

Twin Peaks boulevard has been practically completed. This Avenue ascends on an easy grade to an elevation of 830 feet and encircles the Twin Peaks near their summits. From it is afforded a view of the City and its picturesque surroundings unequaled on the Peninsula.

On the North Bay shore, one section of Camino del Mar, extending from Fort Miley to Lincoln Park along the cliffs above Bakers Beach into the Presidio Reservation, has been completed. For this construction the Panama Pacific Exposition contributed $56,000, and the City approximately $30,000, for rights of way. An extension of this boulevard into the Presidio has been assured by the Federal government. It can then serve both as a military road, affording ready access between Fort Miley and the Presidio, and also as a scenic drive from which an unexcelled close view of the harbor entrance is obtainable.

The first unit of the Esplanade along the Ocean Beach has been completed and the second unit is well under way. When this Esplanade is extended for the total length of the Great Highway from the Cliff House to Sloat Boulevard, San Francisco's Beach will excel in appearance any of the ocean fronts for which Southern California is famous.

To correct some of the mistakes in our rectangular street plan, several excessive grades have been reduced, notably on Hayes Street, Cumberland Street, Collingwood Street and at Larkin and Francisco Streets. All of these thoroughfares were formerly practically unusable by vehicles but since being regraded are readily accessible.

During the past fiscal year more pavements have been constructed in San Francisco under public assessment than in any other single period of the City's history, including:

Asphalt	381,523	sq.	yds.	at cost	of	$730,541
Bituminous Rock	21,520	"	"	"	"	46,191
Basalt Block	18,814	"	"	"	"	64,434
Vitrified Brick	18,828	"	"	"	"	63,083
Broken Rock	29,173	"	"	"	"	22,692
Cobblestone	2,395	"	"	"	"	5,039
Total	472,253	"	"	"	"	$931,980

In June, 1915, bids were invited for furnishing and delivering track and special work for the Church Street Railway, including the material for laying tracks on Market Street. Since that date this line has been completed from Thirtieth to Sixteenth and Church Streets. The City Engineer recommended that an agreement be reached with the United Railroads pending the settlement of the City's right to tracks on Market Street, whereby the Church Street line could be placed in operation immediately upon completion. This recommendation was not acted upon by the Board of Supervisors, with the result that the tracks on Church Street will be idle for an indefinite period.

Contract has been awarded for the extension of the Potrero Avenue line from Twenty-fifth Street to Army Street, the estimated cost of the extension being $10,000.

Bids were invited for furnishing steel rail for track through the Twin Peaks Tunnel, and contract has been awarded for the same.

Over 4300 feet of the Twin Peaks bore have been completed during the past fiscal year. The underground station at Laguna Honda is practically finished and only 4800 lineal feet remain to be completed. As the remaining portion contains no structural difficulties and is in a formation easy to excavate, it is expected that the entire tunnel will be completed before the end of the month of May, 1917.

A Strauss-Bascule bridge is being constructed across Channel Street waterway at Fourth Street, and the bridge over the channel at Third Street has been repaired, so that the newly developed industrial section to the east will be amply provided with avenues of approach.

Work on the main sewers during the past year was confined to the completion of Mile Rock Tunnel and Bakers Beach outlet; the construction of combined sewers in South Bay View District, Oakdale Avenue, San Bruno Avenue and Sloat Boulevard. In the Islais Creek District, a drainage channel was dug along the proposed route of a large reinforced concrete sewer, to reduce to a minimum the danger of floods from winter rains, from which some damage was done last winter.

Work on the Hetch Hetchy project has been materially advanced during 1915-1916. The 67-mile railroad extending from the junction of the Sierra Railway at Rosasco to Hetch Hetchy dam site, is being rushed and should be completed before next spring; a diversion tunnel, through which the Tuolumne River will be by-passed around the main dam site, has been finished; a large proportion of the timber needed for construction purposes has been prepared at the City's sawmill; roads have been built to all portions of the work; a power plant, at which will be generated the electricity for the various construction camps, is being built; the bottom of Hetch Hetchy reservoir has been cleared of timber so that it can be flooded during the coming winter, when the diversion dam, now under construction, will be completed.

Practically all of the application maps required in the Raker Bill have been filed. Application for power line location still remains to be made, but this will be done before December of the present year.

During the past fiscal year, the Department of Surveys established 2505 bench marks; made 1767 surveys for public and private contracts, street repairs, public buildings, etc.; made 40 surveys of lots for private owners; surveyed 6379 blocks and crossings, or a total of 692 miles. Fees collected and turned over to the City Treasurer by this department amounted to $20,623.25.

Instruments have been added to the Engineering Testing Laboratory so that it is now one of the most completely equipped laboratories on the Pacific Coast. In it were tested samples of all material used in City construction, including asphalt, brick, cement, concrete, steel, iron, paints, oils, and water, the total number of tests for the year being 8329.

Following is a detailed report of the various divisions included in Bureau of Engineering.

Respectfully submitted,

M. M. O'SHAUGHNESSY,
City Engineer.

BOULEVARDS.

The economic value of an adequate system of boulevards has not been recognized in San Francisco until recent years. No large city in the United States was so poorly provided with road approaches, and the condition of the main thoroughfare, within the City itself, was not a matter of civic pride.

In outlining a Boulevard System, numerous factors had to be considered. Adequate approaches from the southern end of the Peninsula had to be provided, direct lines of communication between the principal districts of the City established, and suitable routes, from which the desirable features of the City could be viewed, had to be chosen.

Pursuant to the policy of developing to the utmost the City's commercial and scenic possibilities, the Boulevard System has recently been extended.

To provide for the manufacturing district, Railroad Avenue has been paved with asphalt and all excessive grades eliminated. This thoroughfare connects with San Mateo on the south by means of the San Bruno Road, on which paving is now almost completed as far as the County Line. On the north, Railroad Avenue joins with and practically merges into Third Street near the intersection of the latter thoroughfare with Islais Creek. Third Street will soon have a smooth pavement from this junction to its northerly terminus, so that it will be possible to travel through the industrial region on a smoothly paved boulevard 100 ft. wide from Third and Market Streets to the County Line. This route will materially shorten the distance to San Mateo.

Extending easterly from Railroad Avenue along Evans Avenue, a new roadway has been planned to reach Hunters Point drydock. The route will be along Evans Avenue as far east as Ingalls Street; thence on an easy curve to the intersection of Fairfax Avenue and Hawes Street; thence along the last named thoroughfare to Innes Avenue, which will form a portion of the roadway for a distance of four blocks to Donahue Street; thence along Donahue Street to Galvez Avenue, to Coleman Street; thence diagonally to Alvord Street, the entrance to the California Dry Dock Company's property.

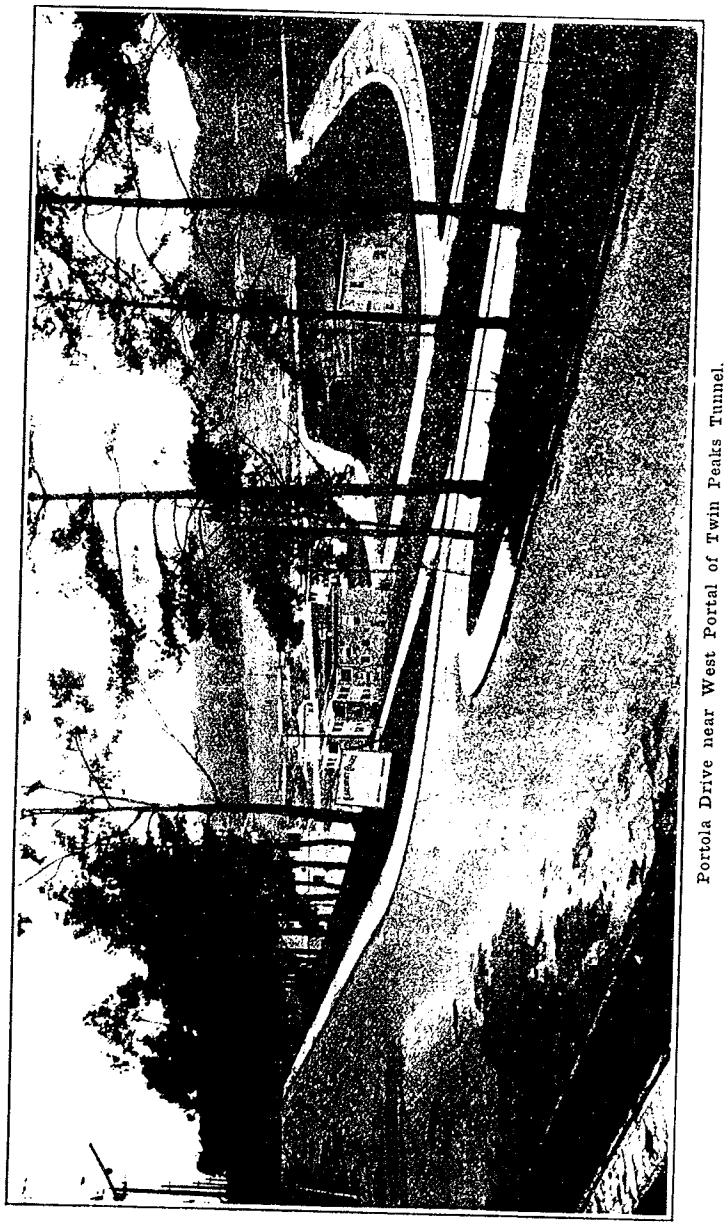
Specifications for the pavement of this roadway have been prepared and arrangements made by which the entire thoroughfare will shortly be constructed, the City paying a portion of the cost, and the remainder to be assessed to the owners of adjacent property.

For many years the industrial district, which will be served by this road, has been absolutely neglected, and many manufacturing enterprises have been forced to seek accommodations in transbay cities or further south along the Peninsula, because there were no adequate roadway approaches to the industrial sites along the east shore of the Bay, which is naturally a manufacturing district. Already the Union Iron Works is building a dock which will be 1,000 ft. long, 120 ft. wide, and cost over $2,000,000, and reached by this roadway.

The Twin Peaks Boulevard now rapidly nearing completion, starts at the intersection of St. Germain and Burnett Avenues, ascends to and encircles near their summits, the two hills known as Twin Peaks at an elevation of 830 ft.; and thence descends to terminate in Corbett Avenue at a point about 900 ft. distant from the westerly boundary line of the San Miguel Rancho.

The roadway consists of an asphalt pavement 25 ft. wide with a 7 ft. 6 in. rock shoulder adjoining it on each side, giving a total width of 40 ft. The pavement is composed of a concrete base 6 in. in thickness, covered by a binder course 1½ in. thick and a 1 in. asphaltic wearing surface. Before constructing any pavement, the subgrade was thoroughly compacted by rolling with a 12-ton road roller.

Surface drainage is carried off by 12 in. corrugated steel culverts, encased in concrete, underlying the roadway at required points. Water collecting in side ditches is discharged into concrete inlets and thence through the culverts.



Portola Drive near West Portal of Twin Peaks Tunnel.

A guard rail consisting of two 2 in. by 6 in. surfaced pine rails nailed to 6 in. by 6 in. surfaced redwood posts 8 ft. apart was constructed in the shoulder adjoining the fill side of the roadway.

The contract for the construction of that section of the boulevard extending from St. Germain Avenue through the City Reservoir site was awarded on June 25, 1915, to Eaton & Smith for the estimated sum of $24,058.

This portion of the boulevard is approximately 2,800 ft. long and its construction necessitated the excavation by steam shovel of approximately 30,000 cubic yards of rock and earth, the construction of 70,000 square feet of pavement and 2,730 lineal feet of guard rail.

The maximum grade on this section of the boulevard is 9% and the sharpest curve has a radius of 60 ft. The roadway on curves is super-elevated to insure safe and easy riding, the maximum super-elevation on the curve mentioned being 14 in.

One of the most notable features of this unit of the boulevard is a curve forming a full semi-circle or horseshoe with a center line radius of 68 ft. To eliminate accidents on this curve, 3,000 cubic yards of rock were excavated in the interior core within the horseshoe to give a clear and unobstructed view across the same.

Work under this contract was completed April 1, 1916, and the roadway thrown open to traffic immediately.

The contract for the second section of the Twin Peaks Boulevard extending from the City Reservoir site to Corbett Avenue was awarded on September 20, 1915, to F. R. Ritchie & Co. for the estimated sum of $54,745.

This unit of the boulevard is about 7,900 ft. long, 6,820 ft. of same being built on an acquired right of way. The contract included the excavation of approximately 63,000 cubic yards of rock and earth and the construction of 202,121 square feet of pavement, 960 lineal feet of 12 in. culvert and 8,000 lineal feet of guard rail.

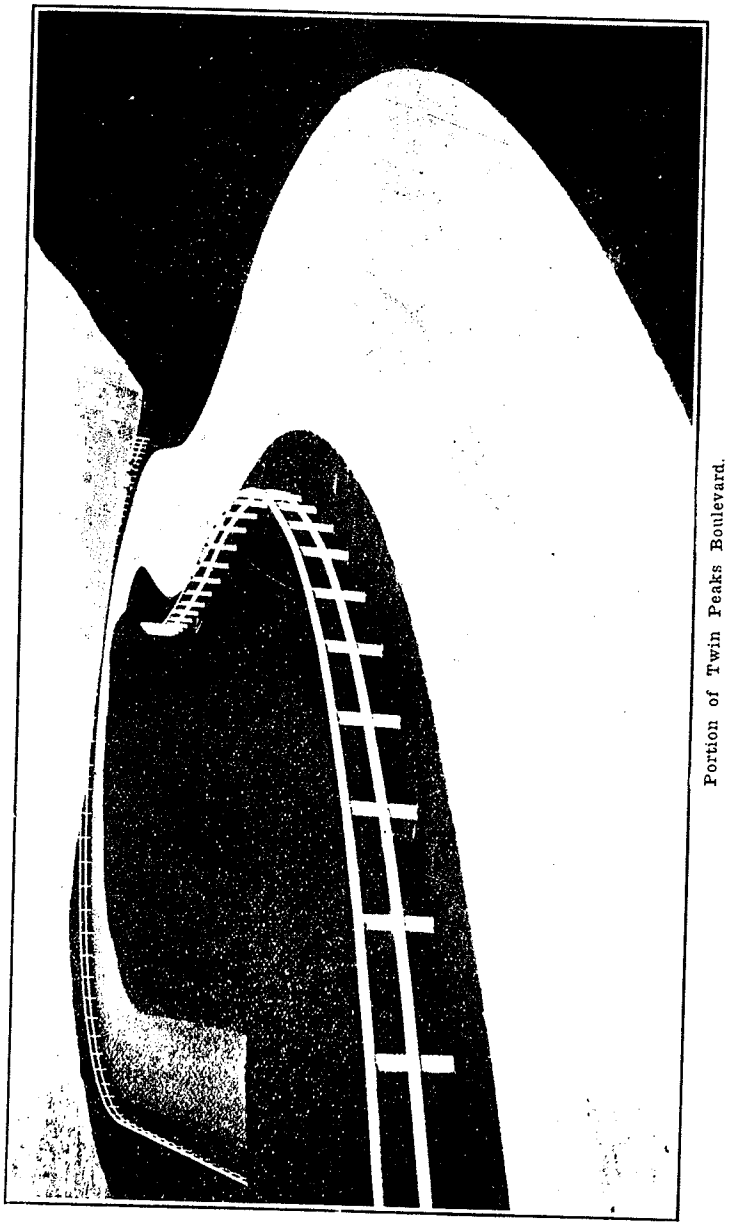
Excavation was performed by a steam shovel. For fills the excavated material was placed in the piles by means of scrapers and dump wagons and thence rolled in layers by a 12-ton road roller. One of the fills underlying the roadway is 60 ft. deep. The surface of the side hills underlying the fills was thoroughly plowed before placing any material for fill.

The maximum grade on this section is 9 per cent and the sharpest curve has a radius on the center line of 60 feet. The roadway has a uniform crown of 2½ in. and it is super-elevated on all curves.

The boulevard encircles the two peaks at approximately the 825 ft. contour, giving a closed loop resembling the figure 8, the distance around same being 3,173 lineal feet.

A magnificent view of the City of San Francisco and surroundings may be obtained from any point on this loop. Work under this contract is now practically completed.

Another boulevard recently constructed is the Camino del Mar, extending from Fort Miley to Lincoln Park, along the cliffs above Bakers Beach into the Presidio Reservation near Lobos Creek, a length of 1,665 ft. This boulevard will serve as a military road, for which reason $30,000 was donated by the Federal government for extending the same through the Presidio Reservation to connect with the McDowell Drive. Eventually the road will be extended to connect with the Marina on the north shore of the Bay, and from Fort Miley southerly to join the Ocean Beach Esplanade, the construction of which is described in detail later in this report. The Panama Pacific Exposition contributed $56,000 for paving and the City $30,000 for acquiring rights of way in this project.



Portion of Twin Peaks Boulevard.

From Camino del Mar, an excellent view of the inner bay and Marin hills is obtainable, and the picturesque scenery along the route is impressive alike to resident and tourist.

A portion of the boulevard system is now in course of construction along the Ocean Beach. Eventually the Esplanade will be extended as far south as the Sloat Boulevard and an additional road will lead from its terminus around Lake Merced. At the present, one section of the Esplanade protection wall is being constructed and the contract for the second section has been awarded.

A scenic road around Telegraph Hill has been planned by the Bureau of Engineering and a small appropriation was requested of the Board of Supervisors which would enable the purchase of some of the lands necessary for its construction. Work on the Telegraph Hill Boulevard should be started during the fiscal year 1916-1917, which would permanently prevent the hill from the inroads of quarrymen.

Work will soon be started on the paving of Clarendon Avenue from Clayton Street southerly to connect these two completed sections around Twin Peaks with the already constructed boulevards leading southerly from Haight Street around Buena Vista Park.

Construction work has been completed on Plan No. 1 of the Market Street Extension, Corbett Avenue between 24th Street and the San Miguel Rancho. This consists of a 20 ft. roadway with two 7½ ft. shoulders, similar in construction to the Twin Peaks Boulevard described above.

The following tabulation shows the progress made on the principal units of the Boulevard System during the last fiscal year:—

	June 30, 1915	June 30, 1916
1 Junipero Serra Blvds.	Completed	
2 Sloat Boulevard	"	
3 Portola Drive	75% completed	Completed
4 Market Street Extension (Corbett Ave. Plan No. 1)	Proposed	
5 Market St. Extension (Plan No. 2)	"	Preliminary studies being made
6 19th Ave. Boulevard	Partly completed	Completed
7 Ocean Boulevard	" "	Finished save portion in Presidio, funds for which Congress recently appropriated
8 San Bruno Extension	" "	Completed
9 The Great Highway and Esplanade	Proposed improvement	Sect. "A" 500 ft. long 65% completed
10 Twin Peaks Blvd.	1st unit awarded	Both units completed
11 Hunters Point Blvd.		Proposed
12 Telegraph Hill Blvd.		"
13 Marina Boulevard		"
14 Twin Peaks Extension		"
15 Clarendon Ave., Clayton to St. Germain		Contract awarded

View of Richmond and Sunset Districts from Twin Peaks Boulevard.

BERNAL CUT.

As outlined a year ago, this improvement is badly needed but its acquisition will have to be deferred until provision has been made to finance the purchase of right of way and cost of construction work.

OCEAN BEACH ESPLANADE.

The first section of Ocean Beach Esplanade now under construction on the west shore of the City just south of the Cliff House by J. D. Hannah, Contractor, was started January 10, 1916. The structure is planned primarily for beach protection, having a front wall formed by driving interlocking concrete piling to depth of 13 ft. below extreme low tide. These piles were precast, are 10 in. thick, 4 ft. wide and 20 ft. long and when in position form a reinforced concrete curtain wall 10 in. thick extending north and south. 28 ft. to the east of this outer line of sheet piles are located pedestal piles 18 in. square with 3 ft. square bulb and 24½ ft. in length and spaced at 10 ft. centers. Between these two rows of piles are placed heavy reinforced beams 20 in. by 43 in. by 27½ ft. weighing 13 tons, which form the main ties, and by means of keyways support the intermediate slabs of concrete. These beams are placed on 20 ft. centers except at stair sections where they are at 10 ft. centers. The space between beams is concreted to form a heavy reinforcing slab, 5 bleacher seats and 3 stringers for additional support. The stringers have a cross section 16 in. by 18 in. The entire section between the beams has a solid bearing on sand and 18 in. of packed clay. The minimum thickness of this bleacher section is 12 in. The last bleacher riser develops into a rollway and this rollway ends at top of and forms part of a 3½ ft. parapet wall with returns at either side of each stairway section. Behind the parapet is a 20 ft. sidewalk with scrupper holes to release wave water, and 6 in. concrete curb and gutter.

Over the front row of sheet piles is a heavy reinforced concrete slab 4 ft. thick and 6 ft. wide which caps the piles and forms a main support for lower ends of beams and intermediate slabs. At the upper end of beams, bearing on pedestal piles is a similar cap which ties the upper portion of slab and structure together. Expansion joints are provided and likewise drinking fountains and electric light connections.

All sheet piles, H beams and pedestal piles were precast, allowed to season for 40 days and then put into position. Most of the precast work was done on the bank above the beach and hauled to position on cars over a construction track. Some were cast on the beach and handled directly by derrick. All piles were driven by 4 water jets and steam hammers.

Two jets of 2 in. pipe reduced to ¾ in. at discharge end were used on each side of sheet piles and one at each corner of bulb on pedestal piles and in both cases were so located that they discharged about 1½ ft. below the bottom of pile.

Water for jetting was supplied by the Olympic Salt Water Co. under static pressure of 130 pounds and nozzle pressure of 40 pounds per jet. Consumption of water by jetting process was approximately 100 cubic feet per minute. The steam hammer was made useful by the fact that the summer beach level is 8 ft. above required grade on sheet piles, and if placed to required grade by jets, it would be impossible to interlock the next pile. Therefore, 10 or 11 sheet piles were placed to sand grade and then with hammer and jets were driven to the required grade, one sheet pile always remaining at sand level to start next pile. Pedestal piles were jetted to required grade without the use of hammer. All jetting was accomplished without very great difficulty. Floating boulders, especially at the north end of the contract, gave some trouble, making it necessary to excavate 8 feet to winter beach level and then remove boulders.

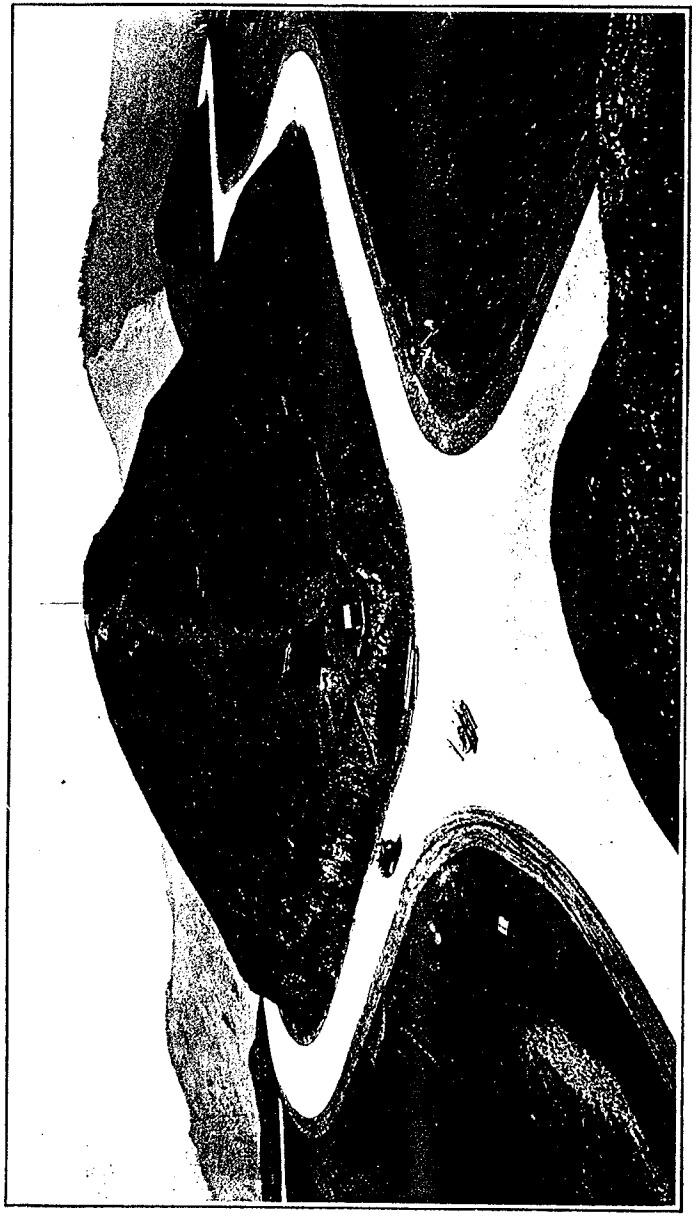


Figure 8 on Twin Peaks Boulevard.

On all precast work the concrete mix was 1-1½-3. The concrete on balance of work will be 1-2-4, the same being used throughout.

At present the driving of all piling is complete, H beams are in place and graded, and sheet piles poured. Bleacher section forms are in place and tamping of sand and clay under bleacher slab is in progress. Over 250 lineal feet of bleachers have been poured. Contract will be completed with the possible exception of sidewalk and backfill by August 1.

Contract for the second unit of the esplanade was awarded in July, 1916, to J. D. Hannah for $23,148.90. This provides for an addition of 170 lineal feet of structure identical with that described above, so that by November 1, 1916, 670 ft. of structure will be completed. It is to be hoped that in the forthcoming budget enough money will be appropriated to complete this deserving project as far south as the chalet pile structure built some years ago.

REGRADES.

On account of the excellent landscape views obtainable from their slopes, some of San Francisco's hills are extremely desirable as residence sites. Unfortunately, however, little thought was given to topography by the surveyor who first laid out the City in 1848. One set of streets was run parallel to the meridian, and another at right angles thereto. The fact that this gridiron plan would later necessitate grades as steep as 55 per cent on some streets and thereby greatly detract from the value of adjoining property, apparently was overlooked until many years later.

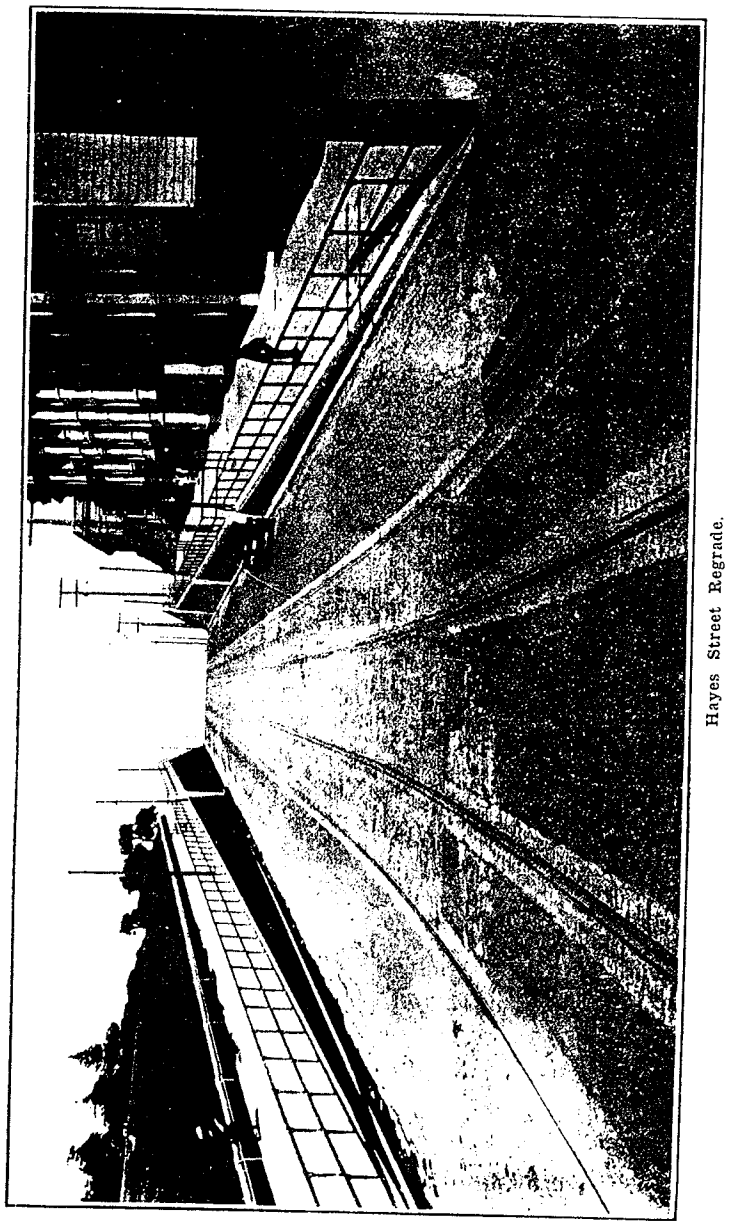
To eliminate, at a minimum cost, as many as possible of these excessive grades has been the policy of the City Engineer's office. No standard plan has been adopted to suit every grade, but a separate study is made of each case, and the improvement best adapted thereto recommended.

At the request of the property owners affected, the grade of Larkin Street between Chestnut and Francisco Streets has recently been reduced from 29 per cent to a maximum of 16 per cent. The cost of this improvement is being paid by the owners having frontage on the streets to be regraded. On Larkin Street $16.31 per front foot will be assessed against the property on each side of the street, and on Francisco Street the rate will be $20.29 per front foot. Present property values on both these streets are now in the neighborhood of $115 per front foot. The regrade will advance this value to over $250.

For a width of 28 ft. the east side of Larkin Street between Chestnut and Francisco Streets has been cut down to descend on a uniform 16.07 per cent grade. On this incline is an 18 ft. vitrified brick roadway and a 10 ft. artificial stone sidewalk. This strip is separated from the west side of the street by a reinforced concrete retaining wall, and near the bottom of the hill turns westward into the southerly side of Francisco Street. The west side of Larkin Street has been graded to a higher elevation than the east side, and descends on grades varying from 4.37 to 10.92 per cent, for a distance of 157.5 ft., where its vitrified brick roadway 28.25 ft. wide terminates in a parked slope. At its termination the west roadway is 12 ft. higher than the east roadway directly opposite. The sidewalk continues down the west side in a series of steps to the level of the easterly strip at Francisco Street.

Turning westerly, the steeper strip continues to descend on a 16 per cent grade along the south side of Francisco Street for a distance of 127.5 ft., separated from the north side of the street by a reinforced concrete retaining wall. Around the westerly end of this wall the roadway turns through 180 degrees, descending easterly along the north side of Francisco Street on a 3.6 per cent grade, back to Larkin Street, into which it turns northerly.

By this detour a roadway suitable for automobile traffic has been provided from the North Beach District to the higher levels on the south, and some very



Hayes Street Regrade.

desirable hillside home sites, now inaccessible and undeveloped, opened for immediate settlement.

Contract for this construction was awarded to F. Rolandi at an estimated cost of approximately $30,000. The construction will be completed in the immediate future.

The entire expense of this work is being paid for voluntarily by the property owners, without any appeal to the municipal treasury. They co-operated with this office in the most friendly manner to adjust the problems connected with this work.

HAYES STREET REGRADE.

This improvement has recently been completed and consisted of cutting the roadway down between curb lines for a maximum of 15 ft., thereby establishing a 10.909% grade between Scott and Pierce Streets in lieu of the 14.54% grade previously existing, and lowering the intersection of Pierce and Hayes Streets an average of 14 ft. Retaining walls at the curb lines form the sides of the cut, stairways being provided at intervals connecting the street with the sidewalks on the upper level. Sewers and public service pipes were placed under the sidewalks. The Hayes Street electric car line which formerly detoured at Fillmore Street to reach the district west of this regrade now continues directly over Hayes Street through the new cut, effecting considerable saving in time and power. On this work 11,500 cubic yards of excavation was done by the Street Railway Company while the City paid $16,000 for the balance of the improvement.

Bids are about to be received for the improvement of Cumberland Street, Sanchez to Noe Streets, and Sanchez Street, 19th to 20th Streets, and proceedings have been started for the improvement of Leavenworth Street, Chestnut to Hyde Street.

Collingwood Street, 20th to 22nd Streets, and 21st Street and 22nd Street between Castro and Diamond Streets, are to be treated shortly to improvements that will tend to make accessible this very precipitous district.

Other projects of a similar nature are:—

Bartol Street, Vallejo and Broadway, Kearny and Montgomery Streets;
Caselli Avenue, Falcon and Eagle;
Caselli Avenue, Clayton, Corbett, Mars.

MUNICIPAL RAILWAYS.

CHURCH STREET ROAD

Article XII of the new Charter of the City and County of San Francisco which became effective January 8, 1900, declares it to be the intention of the people that its public utilities shall be gradually acquired and ultimately owned by the City and County of San Francisco.

With particular regard to the ownership and operation of its street railway system, this policy may be considered to have been ratified by the people when on December 30, 1909, at a special election they voted $2,020,000 of bonds for the construction of the Geary Street Railway, the franchise for the old Geary Street Cable Road having expired in 1903. With this money the Geary Street Municipal Railway was constructed and operation from Kearny Street to the Beach and Park commenced on December 28, 1912; on June 24, 1913, operation was extended to the Ferries.

The Panama-Pacific Exposition a little later made imperative the immediate expansion of the Municipal Railway System to provide transportation to and from the fair grounds. The site selected for the Exposition, while ideal in some

respects, was somewhat inaccessible and presented a serious problem in the matter of street transportation. The only lines running anywhere near the Exposition were the Fillmore Hill and the Polk Street Lines of the United Railroads and the Union Street Line. The exposition directors, City officials and Railway officials were impressed with the need for action and gave the matter early and serious consideration. In addressing the Board of Supervisors on the subject on February 5, 1913, C. C. Moore, President of the Exposition Company, said: "I do not think we are saying too much when we say that the burden of supplying adequate street railway transportation to the Exposition belongs to the City and not to us. We want to tell you how desperate this is, how utterly and completely inadequate the present facilities are. * * * With no street car facilities to the Exposition Grounds our $100,000,000 structure, built by our pride and our patriotism, so far from fruition, will be a sad thing to contemplate."

At the same meeting, Mr. Mullaly, Exposition Director, and Vice President of the United Railroads, stated most emphatically that "The United Railroads will not build one foot of additional street railroad under present charter conditions."

Confronted with these conditions, upon the request of the Directors of the Panama-Pacific International Exposition, the Board of Supervisors by resolution directed the Board of Public Works to have the City Engineer submit plans and estimates of cost of a Municipal Railway System designed to furnish to the Panama-Pacific Exposition an adequate street railway service and at the same time form a nucleus for a desirable Municipal Railway System.

In accordance with this resolution the City Engineer on April 5, 1913, submitted to the Board of Public Works for transmittal to the Supervisors, a report upon the extensions of Municipal Railways to provide transportation for the Panama-Pacific International Exposition. Acting upon this report, the question of a bond issue of $3,500,000 for constructing the lines recommended therein was submitted to the people and overwhelmingly carried at an election held August 26, 1913.

The subsequent program of prompt and efficient construction under the supervision of this department—all work being completed on time—provides a unique exhibit of municipal efficiency.

The Exposition has since passed into history, but it is of interest to review a few of the figures bearing upon the attendance and the transportation that it may better be appreciaed how necessary these lines were to the success of the Exposition and how well the demands were met.

The total attendance at the Exposition for the 288 days was 18,875,974. It is estimated that at least 50 per cent of this number was handled on the Municipal lines, representing approximately $1,000,000 in fares due to the Exposition traffic alone.

The greatest attendance for any single day was on closing day, December 4, when 458,558 people attended the Exposition. The Municipal Railway receipts on this day were $16,748.20, representing 334,964 cash fares; or in other words, 36½ per cent of the total attendance rode both ways on the Municipal lines.

The second largest day was San Francisco Day, the attendance being 348,372, the railway receipts $13,922.75, or 40 per cent of the attendance both ways.

The third largest day was opening day, 255,149, when the railway receipts were $13,299.70, or 52 per cent of the attendance. All of these days were holidays and practically all of the business handled by the roads was Exposition traffic. The reduction of the percentages as the attendance of 255,000 was exceeded, indicates that the capacity of the lines was practically reached on these three days that the crowds were not comfortably handled. The pre-Exposition estimate was that there would be at least one day in excess of 250,000 attendance.

The total Municipal Railway receipts for the Exposition year were $2,255,841.15 to apply to interest, depreciation and reserves. It is interesting to note

that this surplus represents practically the total cost of the track construction for the Exposition extensions.

Of all the lines provided for under the 1913 Bond Issue the Church Street line was the only one not completed for service prior to the opening of the Exposition.

An examination of the Journal of the Board of Supervisors will reveal the extent and bitterness of the controversy aroused at the time that the construction of this road was up for consideration. Briefly, the history of this Church Street controversy which was the cause for the delay in the construction of this line, is as follows:—

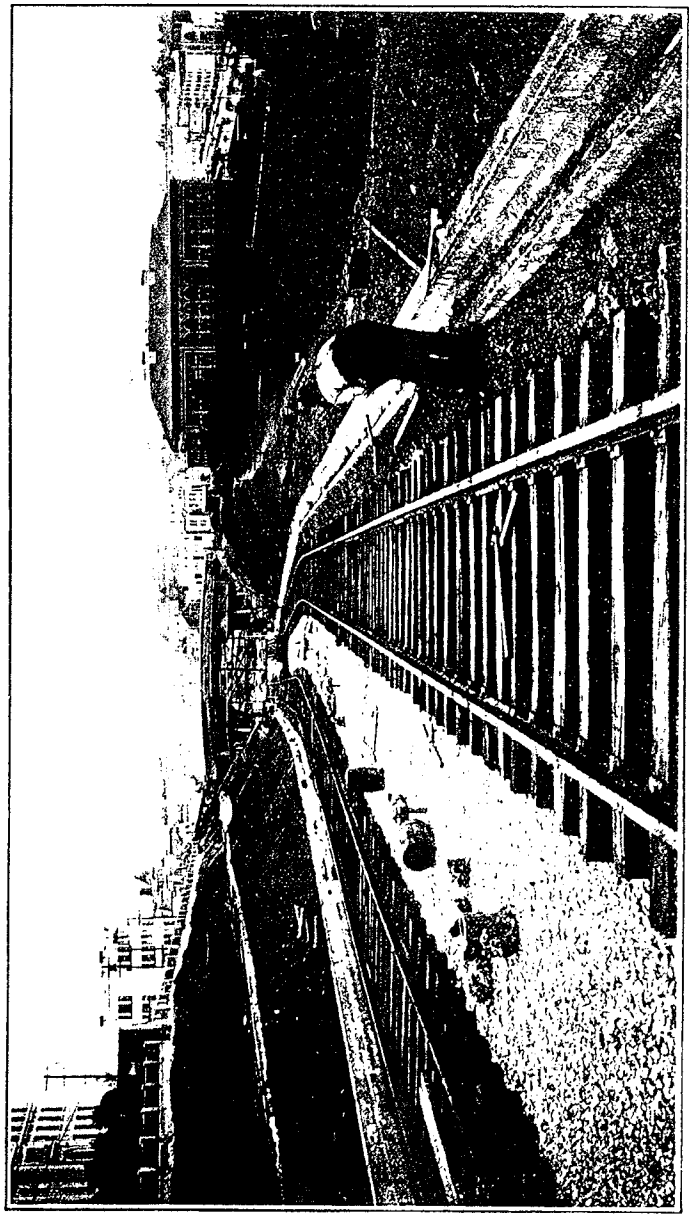
The City Engineer recommended that the Church Street line be diverted from Church Street through Mission Park and a private right of way acquired from 18th to 22nd Sts., for the purpose of making a detour to overcome the extreme grade of 19.3 per cent on a direct route over Church Street between 20th and 21st Streets. In connection with this diversion it was planned also to open a street along the railroad grade for the accommodation of vehicular and pedestrian traffic, the cost of opening this street to be paid for by an assessment on the property benefited. The assessment feature aroused a storm of protest from a number of the affected property owners.

In an endeavor to effect a solution of this Church Street problem satisfactory to all interests, some nine comprehensive studies were made by the City Engineer, including, by an order of the Board of Supervisors, the preparation of complete plans and specifications for a cable operated road over the hill. After protracted discussion by the Board of all the possible solutions, which lasted for eighteen months, on February 8, 1915, the Supervisors passed an ordinance empowering the Board of Public Works to authorize the City Engineer to prepare plans, specifications and contracts and advertise for bids for furnishing necessary material for constructing the Church Street extension of the Municipal Railway System and approving the plan for overcoming the grades between 18th and 22nd Streets by a diversion through Mission Park and private property between 20th and 22nd Streets. This plan, as finally approved, follows closely the original recommendation of the City Engineer as to location, but the right of way was narrowed to 28 ft. and is without provision for pedestrian or vehicular traffic. Under pressure of the protestants organized as the Church Street Non-Assessment League, the Supervisors agreed that the City would assume the expense of opening the railroad right of way, thereby adding something over $150,000 to the charges against the railroad construction.

By comparing the finally adopted plan with the tunnel project suggested in Arnold's report, Page 278, which would have cost $100,000 more to execute and be less desirable for use, the City is to be congratulated on the final outcome and much well deserved credit should be given to Messrs. Ransom and Eckart of this office for their intelligent zeal in furthering this work.

Acting upon the ordinance authorizing the construction in June, 1915, bids were invited for furnishing and delivering the track special work for the Church Street Line, including the track special work for laying outer tracks on Market Street. The question of purchasing this material for the outer tracks on Market Street was put up to the Supervisors, but no decision was reached until December 1, 1915, when the Board of Public Works was authorized to purchase all of the materials for the Church Street Line except those for the outer tracks on Market Street from Van Ness Avenue to Church Street.

Contracts were awarded for constructing one section of the Church Street Line from 18th to 22nd Streets, and another section from 16th to 18th Streets and from 22nd to 30th Streets. Both of these contracts have been completed prior to July, 1916, but owing to a controversy with the United Railroads and an injunction, the City has been unable to connect its Church Street tracks with the other tracks of its system. The City Engineer's office had previously taken



Grade for Detour on Church Street Railroad.

this matter up and agreed with the engineers of the United Railroads on the valuation of the tracks between Market Street and 16th Street on Church Street, which tracks formed a part of the Church Street Line under the original plan. Arrangements also were made with the United Railroads by which connection would be made with the United Railroads tracks on 16th Street at Potrero Avenue and at Church Street for the purpose of permitting temporary routing to and from the Potrero Avenue car barn from the Church Street tracks, the City paying the United Railroads a nominal charge for current and wear and tear on the track and overhead. Pending the settlement of the question of the City's right to lay tracks on Market Street, the United Railroads agreed to an exchange of transfers at Church and Market Streets. These arrangements, which offered a temporary solution for the operation of the Church Street Road, were never consummated owing to the refusal of the Board of Supervisors to allow the exchange of transfers at Church and Market Streets on a 40-60 basis, that is, redeeming Municipal transfers for three cents from the United Railroads and allowing the United Railroads to redeem their transfers to Church Street on a two cent basis. This interchange was recommended by the City Engineer's office as being equitable based on the ratio of the lengths of the lines involved, the Church Street line being approximately 9,000 ft. against 14,000 ft. operated by the United Railroads on Market Street.

In order to precipitate matters and bring the questions into court for a final settlement of all the questions involved, the City commenced the installation of the outer tracks on Market Street at Van Ness Avenue on June 12, 1916, but were stopped from proceeding by an injunction secured in a Federal Court. This matter is still in the courts at the present time and it will probably be several years before it is finally settled as both the City and the United Railroads are determined to carry the matter to the highest tribunal.

In the meantime, a second contract for purchasing track special work for the Market Street section of the Church Street Line has been awarded to the United States Steel Products Company, which provides that the City may order this material at any time within a period of one year or abandon the contract, so that whenever this matter is settled favorable to the City, work can proceed immediately on the construction of the track.

Owing to the complex proposal connected with the Church Street work, it is interesting to recite the different public proceedings incident to the successful completion of a portion of this work:—

CHURCH STREET LINE—MUNICIPAL RAILWAYS

Connection between Van Ness Avenue and Church Street.

June 29, 1914—Resolution directing Board of Public Works to prepare plans and specifications for the construction of the Church Street Line from Market Street and Van Ness Avenue to Dorland and Church Streets to 30th and Church Streets, and that the construction of this unit be proceeded with as soon as possible, owing to difficulty in getting satisfactory plans for portion between 22nd and Dorland Streets.

Motion introduced; laid over 3 weeks.

Aug. 3, 1914—Above motion reported on adversely by Public Utilities Committee and refused passage, 10 to 6.

Dec. 21, 1914—Ordinance authorizing Board of Public Works to prepare plans and specifications and contracts, and advertise for bids for material for constructing the Municipal Railway along Market to Church Street and along Church Street to the northerly line of 18th Street. Introduced by Vogelsang; referred to Public Utilities Committee.

Jan. 4, 1915—On motion of Supervisor McCarthy, consideration of ordinance laid over 2 weeks; 13 to 4.

Jan. 19, 1915—Ordinance authorizing construction of Church Street Line from Van Ness Avenue out Market Street to 18th and Church Streets; brought up and made special order of business for the following Thursday at 3 P. M.

Jan. 21, 1915—J. R. 1626, introduced by Power, requesting City Engineer to present estimate of cost of Church Street road, utilizing United Railroads trackage now in place on Market and Church Streets; carried unanimously.

Ordinance authorizing Board of Public Works to prepare plans and specifications for the construction of the Church Street extension from Van Ness Avenue and Market Street to 18th and Church Streets, indefinitely postponed on motion of Supervisor Vogelsang.

Jan. 25, 1915—Motion introduced by Supervisor Power requesting United Railroads to advise Board of Public Works to enter into agreement with City for use of Market Street tracks; lost 8 to 8.

Feb. 1, 1915—Report of City Engineer dated January 27, 1915, showing estimate of cost of constructing Church Street Line, recommending that authority be given the Board of Public Works to immediately advertise for bids for furnishing material and labor necessary to construct the Church Street extension from Van Ness Avenue and Market Street to 30th and Church Street, and recommending that the Board of Supervisors pass a resolution indicating whether they desire that additional tracks be constructed outside of the United Railroads tracks on Market Street from Van Ness Avenue to Church Street or to use the United Railroads tracks on this street.

Thereupon Supervisor Vogelsang presented a bill directing the Board of Public Works to prepare plans and specifications for the construction of the Church Street extension. Passed to print.

Feb. 8, 1915—Ordinance authorizing Board of Public Works to advertise for bids for constructing the Church Street road from Van Ness Avenue and Market Street to 30th and Church Streets; adopted 11 to 6.

J. R. 1662 introduced by Vogelsang, authorizing Mayor and City Attorney to enter into negotiations with the United Railroads for the joint use of tracks on Market Street. Carried unanimously.

June 19, 1915—Board of Public Works invited bids for furnishing and delivering track special work for the Church Street line, including track special work for outer tracks on Market Street from Van Ness Avenue to Church Street.

June 26, 1915—Board of Public Works called for bids for furnishing and delivering steel rails, rail fastenings and joints for the Church Street Line.

July 9, 1915—Letter from City Engineer to the Board of Public Works recommending that the question be submitted to the Supervisors and a decision obtained from them as to whether or not it is their intention to have outside tracks constructed on Market Street.

July 22, 1915—Recommendation of City Engineer to award contract for track special work and advising contractor not to execute work until policy settled.

July 27, 1915—Letter from City Engineer to Board of Public Works awarding contracts for various materials and recommending contract be held up pending settlement by the Supervisors as to the question of constructing outer tracks on Market Street.

Sept. 20, 1915—Communications from the City Attorney and Mayor relative to negotiations with the United Railroads for the use of the Market Street tracks, indicating that no agreement was probable.

Dec. 1, 1915—Approximately, Public Utilities Committee, Board of Supervisors, authorized purchase of all materials not actually involved in constructing outer tracks on Market Street.

Dec. 7, 1915—Report of City Engineer to Public Utilities Committee suggesting three possible solutions for operation on Church Street Road.

Jan. 3, 1916—Bill No. 3907 authorizing submission of an offer to United Railroads for purchase of west of Twin Peaks Tunnel Line with provision for interchange of transfer at Church and Market, etc. Recommitted to Public Utilities Committee.

Apr. 3, 1916—Resolution No. 12,772 (new series) accepting offer of United Railroads for use of tracks on 16th Street from Potrero Avenue to Church Street. Accepted. Passed 17 votes.

May 1, 1916—Resolution No. 12,887 directing Board of Public Works to proceed with construction of outer tracks from 16th and Church Streets to Van Ness Avenue and Market Street. Adopted. 17 votes.

May 2, 1916—United Railroads refuse to allow installation of track crossing at 18th and Church Streets.

May 4, 1916—Conference Mayor Rolph, Judge Sullivan, M. M. O'Shaughnessy, N. A. Eckart; decision made to install 18th Street crossing on Saturday afternoon and Sunday.

Apr. 29, 1916—Section "C" of Church Street Line completed.

May 13, 1916—Commenced installation of crossing at 18th and Church Street at 1 P. M.; in place ready for operation of United Railroad cars Sunday morning.

May 14, 1916—Connected up rails of Section "C" with crossing.

May 18, 1916—Letter withheld from Board of Public Works.

May 19, 1916—N. A. Eckart in consultation with Mayor Rolph relative to installation of crossing at Van Ness Avenue and Market Street.

June 9, 1916—Conference, Mayor Rolph, Judge Sullivan, George Lull, M. M. O'Shaughnessy, N. A. Eckart, relative to installation of tracks on Market Street and laying foundation for suit.

Decided to install crossing at Van Ness Avenue and Market Street on June 12.

June 12, 1916—Resolution of Board of Public Works authorizing City Engineer to construct outer track on Market and Church Streets by day labor.

1 P. M. commenced opening street to install crossing.

June 13, 1916—Enjoined from further work.

June 28, 1916—Section "B" track work completed.

July 21, 1916—Contract No. 81 for installation of trolley wires completed and road ready for operation except connection with United Railroads.

Aug. 22, 1916—Judge Hunt (U. S. Circuit Court) commenced hearing of case.

Aug. 25, 1916—Completed hearing of case. Fixed October 10 as date for submission of final briefs of United Railroads in rebuttal.

In the last annual report mention was made of the proposed extension of the Municipal Railway across Golden Gate Park from 10th Avenue and Fulton Street to 14th Avenue and Judah Street, the plans and specifications for which road at that time were approximately 90 per cent completed. Upon the completion of these plans, they were submitted to the Board of Park Commissioners in November, 1916, with the request that the Park Commissioners give their consent to the construction of this line in accordance with the plans prepared. This request was met with absolute refusal and with the counter-suggestion that if the Park was to be crossed it should be in the vicinity of 20th Avenue and then in a subway or tunnel. The cost of such a tunnel being in the neighborhood of $800,000 was of course absolutely prohibitive and warranted no consideration. Following upon this action by the Park Commissioners, the Board of Supervisors passed a resolution directing the Board of Public Works to immediately proceed with the construction of the line across the Park in accordance with the plans prepared under the original ordinance. This resolution was vetoed by His Honor, Mayor Rolph, and later failed of securing the necessary votes to pass over the Mayor's veto. Immediately prior to vetoing the resolution, the Mayor called a conference of the Park Commission and representatives of the Supervisors and the City Engineer in an endeavor to reach some solution. At this conference the Park Commission remained firm in their stand to oppose the construction of the Golden Gate Park Line between 10th Avenue and Fulton Street and 14th Avenue and Judah Street, but offered as a compromise to permit a surface crossing at 20th Avenue, the crossing to follow the City Engineer's plans as developed for the original location. Due to the excessive outlay involved for this 20th Avenue route, the loss of earnings from the missing patronage of the music stand region the desirability of its construction now may be well questioned if the funds are available. The construction of the line across Golden Gate Park is at present in a somewhat anomalous condition. There is an ordinance authorizing and directing the Board of Public Works to construct this line between 10th Avenue and Fulton Street and 14th Avenue and Judah Street and the City Attorney has held that the Supervisors have the authority to order the construction of this line across the Park regardless of the opposition of the Park Commission provided that such road does not interfere with the free use of the Park for park purposes. Eminent attorneys, on the other hand, question this and nothing but a Court decision can absolutely determine the question. In view of this it is doubtful if any line will be built across the Park for some time to come.

In conjunction with the extension of Potrero Avenue south this office has recommended, and the Board of Supervisors have authorized, the construction of an extension to the Potrero Avenue Line from 25th Street, at the present terminus, to Army Street, the estimated cost of the work being $10,000. This short extension was determined on in view of the fact that, by constructing the track in advance of the pavement, a saving of approximately $2,500 would be effected in the ultimate cost of the Potrero Avenue extension by avoiding the necessity of tearing up new pavement to lay tracks. Contracts for furnishing the track special work have already been awarded and contracts for the track work will be let at such time as to permit of the track being laid following the completion of the heavy excavation.

Upon the recommendation of this office the Supervisors have appropriated $275,000 from the surplus earnings of the Municipal Railway System for the purpose of constructing the track and overhead work through the Twin Peaks Tunnel from 17th and Market Streets to the junction of Sloat and Junipero Serra Boulevards. The ordinance authorizing this construction also provides for a connection from the west portal of the Twin Peaks Tunnel out Taraval Street to the Ocean Beach. The additional money necessary for completing this portion of the line has not as yet been appropriated. Bids have been invited for furnishing the steel rail for the track work through the tunnel and other contracts

will be let at such times as may be necessary to provide for the completion of the Twin Peaks Line at the earliest date the progress of the tunnel will warrant.

The City Engineer has on several occasions orally and in written reports advised the Board of Public Works and Supervisors of the necessity of preparedness in having adequate transportation facilities arranged so as to reap the fullest benefit to the City immediately on the completion of the $4,000,000 Twin Peaks Tunnel. San Francisco is suffering from lack of adequate rapid transit to the outlying sections, and while the problem is involved and complex, the City authorities have shown so much constructive ability in the past four years in overcoming other obstacles that it is hoped some immediate attention and consistent effort will be given to this pressing subject.

The street railway situation in San Francisco presents a number of serious problems. The track mileage in the City is more than five years behind the needs of the present population. It is difficult to extend the street railway facilities logically or economically because of the fact that all of the railway lines are not under a unified control. The City cannot force the United Railroads to make any extensions nor will the United Railroads make any extensions of their own volition under existing Charter conditions. Many extensions are at present desirable but without suitable connections or transfer arrangement with both the Municipal Railway and the United Railroads system would be of little real benefit. The more carefully the situation is studied the more urgent appears the necessity for the unification of control of all the existing railroad lines, and until this has been accomplished San Francisco will have to put up with a more or less inadequate transportation system. This office at the present time is studying the problem and expects to make a report shortly outlining a logical program for future extensions of the existing Municipal Railway System, but at the best the construction of these extensions will fall short of solving the transportation question in San Francisco, for the solution of this problem requires consideration on broader lines.

The time is fast approaching when a rapid transit system must be considered. This would be either of subway or elevated type, preferably the latter, at this stage of our development, the comparative costs being about $800,000 a mile for the elevated as against $3,500,000 a mile for the subway construction. The first link in a rapid transit system naturally should parallel Market Street connecting with the Twin Peaks Tunnel and with a branch extending south through the Mission in the vicinity of Capp Street.

STATEMENT OF 1910 GEARY AND MARKET STREETS BOND FUNDS.

EXPENDITURES.

Prior to July 1, 1915		$1,948,602.05
From July 1, 1915, to July 1, 1916:		
Ferry outer loop on Embarcadero, Lower Market Street	$ 2,058.50	
Car Barn Extension, Geary Street Railway Tank and Tower Foundation	645.20	
Carn Barn, Second Story, Geary Street Railway	29,170.57	
Carn Barn—Construction Tank and Tower	1,482.00	
Carn Barn Construction—Completing Heating System	341.14	
Extra Parts and Equipment	423.93	
Plans and specifications	306.35	
Total during last fiscal year		$ 34,427.69
Total to date		$1,983,029.74
Available for future expenditures		43,282.16
Total sale of bonds, miscellaneous sources and unsold bonds		$2,026,311.90

TWIN PEAKS TUNNEL.

The general engineering features of Twin Peaks Tunnel were described in the report of the City Engineer for the fiscal year 1913-1914. The project has been advanced efficiently and economically and all of the serious construction problems encountered so far have been solved satisfactorily.

The close of the fiscal year 1914-1915 found the contractor at Station 8+10, some two hundred feet underground at the west end; with 25% of Laguna Honda Station excavated; the vent shaft in the Relief Home Tract fairly well started and the subway section completed on the easterly end. Practically 4,300 feet of completed tunnel has been constructed during the 1915-1916 fiscal year.

An obstruction, presenting some difficulty and successfully handled, occurred about 1800 feet from the west portal. A brick lined water duct of the Spring Valley Water Company constructed in 1865 crossed at a sharp angle 8 feet above the tunnel arch. It was conveyed by means of a by-pass over the completed tunnel. A shaft was sunk, the water duct tapped by a 30" pipe, which ran west 275 ft. in a drift previously driven, crossed the tunnel at right angles and connected with the original duct again. Later the water was permitted to follow the original course. The entire section of tunnel between the west portal and the Laguna Honda Station has been completed.

Excavation for Laguna Honda Station and 22 ft. of tunnel section on each end was done in open cut, the maximum depth being 70 ft. Steam shovels carried the cut to within 15 ft. of rail grade, the sides of the pit being retained by piles. Trenches were then dug by hand for the side walls and footings of the station, after which the concreting was done and then the core of earth was removed. The waste material, a sandy clay, hauled an average distance of 1/3 mile in motor trucks, was used in filling low portions of the valley in which the station is built. Station is completed except the superstructure.

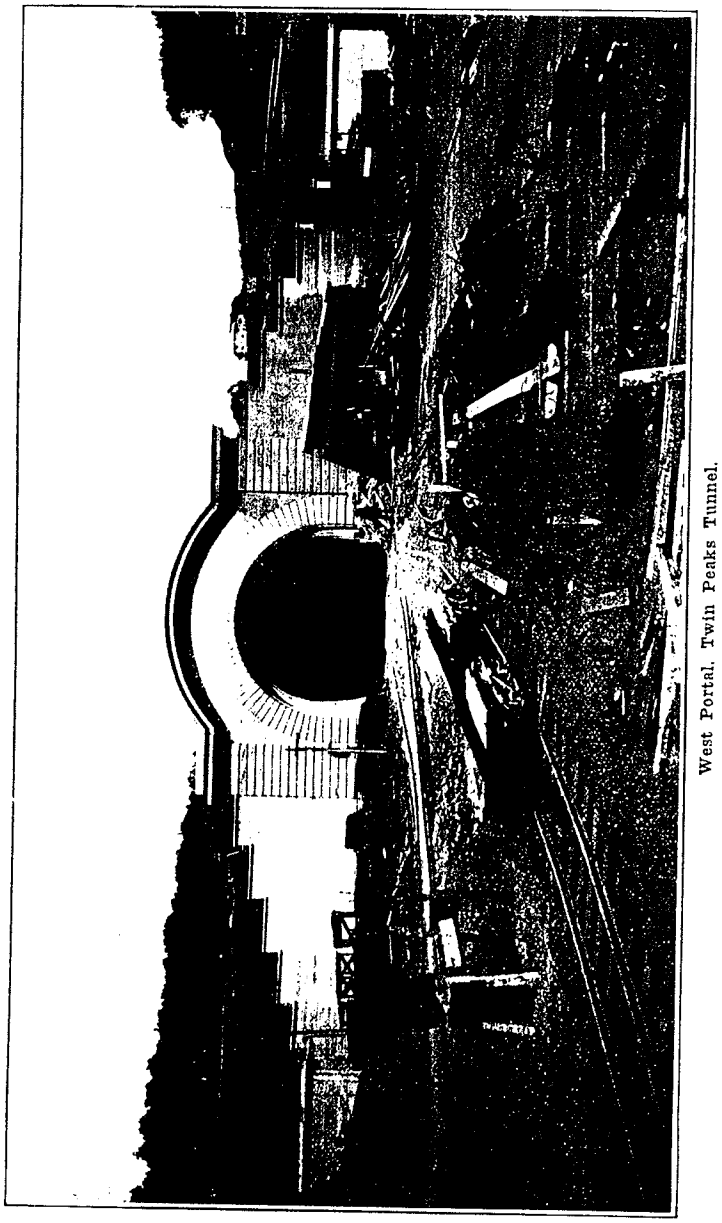
Because of an ascending grade, excavation between the vent shaft and the Laguna Honda Station was started from the former. The shaft when completed will have an inside diameter of 13 ft. but the excavation was made 20 x 32 ft. so as to take in full width of tunnel section and to permit of construction of forms for concreting. From the bottom of this shaft, 100 ft. deep through water bearing sand and timbered with piles held by 12 x 12 bracing and walings hung with steel hangers, a drift was carried 300 ft. westerly at invert grade through sandstone, when it broke through the sandstone into a waterbearing sand, causing 300,000 gallons per day to be lifted out at the shaft. Another drift was then started and kept in the sandstone until after the sand deposit was passed, when the second drift was brought up to line with the first one. Easterly from Laguna Honda tunneling has been projected over 411 ft. on the descending grade toward the vent shaft, the drift previously driven draining the ground penetrated. Concreting follows within free working distance of the finished timber lining.

Excavation for that section between the east portal and a point 500 ft. southwesterly therefrom, was done between two rows of piles and heavy timbering with the necessary cross braces. This ground was a filled in creek bed and the 30,000 cu. yds. of excavation was removed by pick and shovel. This portion of the tunnel has been constructed and the backfilling finished.

Adjacent to the section just described or at Station 97 + 15, the tunneling proper on the east end was started and was driven westerly to Station 87 + 63, leaving to be completed those portions between Station 46 + 57 and 87 + 63 and between Station 46 + 37 and 39 + 00 or 4,843 lineal feet, together with the superstructure of Laguna Honda Station.

In the light of the progress made during the past fiscal year when so many adverse conditions were encountered, and the fact that the greatest portion of the work remaining to be done is in rock, there is not any apparent reason to question the forecast that April, 1917, will see the east and west facings meet and the tunnel completed.

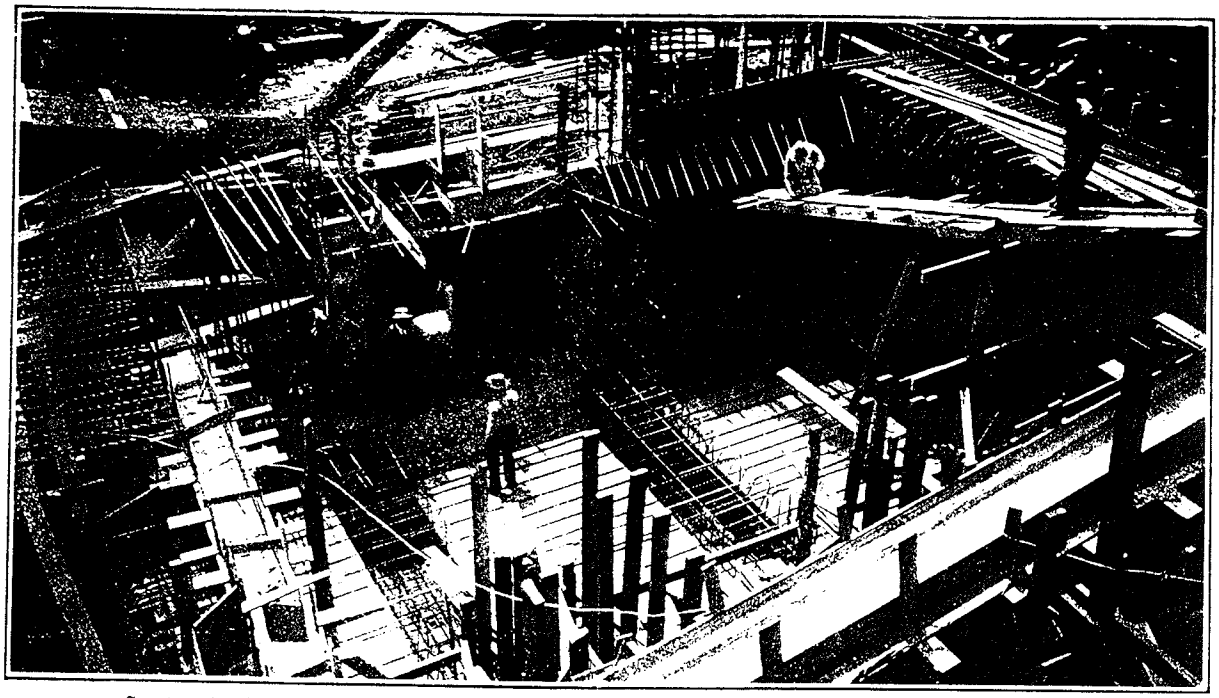
R. C. Storrie & Company, to whom this contract was awarded, for the estimated sum of $3,372,000, have performed work the estimated value of which to date is $2,168,539.38.



West Portal, Twin Peaks Tunnel.

TABLE 1—ALIGNMENT, GRADES AND SUBDIVISIONS

		Grade		Distance on		Curve	
		Ascend	Descend	Tangent	Curve	To	Radius
West Approach	0-00 to 0-83	.015		83.000			
Tunnel Section	0-83 to 17-27.26	.015		1,644.260			
	17-27.26 to 30-31.44	.015			1304.183	Right	5,729.65
	30-31.44 to 30-73	.015		41.557			
Laguna Honda Sta.	30-73 to 33-73	.015		300.000			
	33-73 to 34-30.10		.03	57.103			
	34-30.10 to 36-60.10		.03		230.003	Right	5,729.65
	36-60.10 to 47-13.00		.03	1,052.894			
Ventilating Sta.	47-13 to 47-26.00		.03	13.000			
Tunnel Section	47-26 to 98-64.00		.03	5,138.000			
Taper Connection	98-64 to 100-44.00		.03	180.000			
29′ 6″ Tunnel Sect.	100-44 to 100-74.00		.03	30.000			
	100-74 to 103-76.81		.0287	302.816			
	103-76.81 to 104-96.23		.0287		119.420	Right	1,555.49
	104-96.23 to 108-52.73		.0287		356.500	Right	1,017.95
	108-52.73 to 109-72.15		.0287		119.420	Right	1,555.49
	109-72.15 to 111-45.76		.0287	173.610			
Eureka Valley Sta.	111-45.76 to 114-45.76		.0140	300.000			
Subway Section	114-45.76 to 114-85.61		.0140	39.850			
	114-85.61 to 117-33.56		.0140		247.950	Left	861.37
	117-33.56 to 117-38.76		.0140	5.200			
East Approach	117-38.76 to 119-25.76	.0424		187.000			
				9.548.290	2377.476		



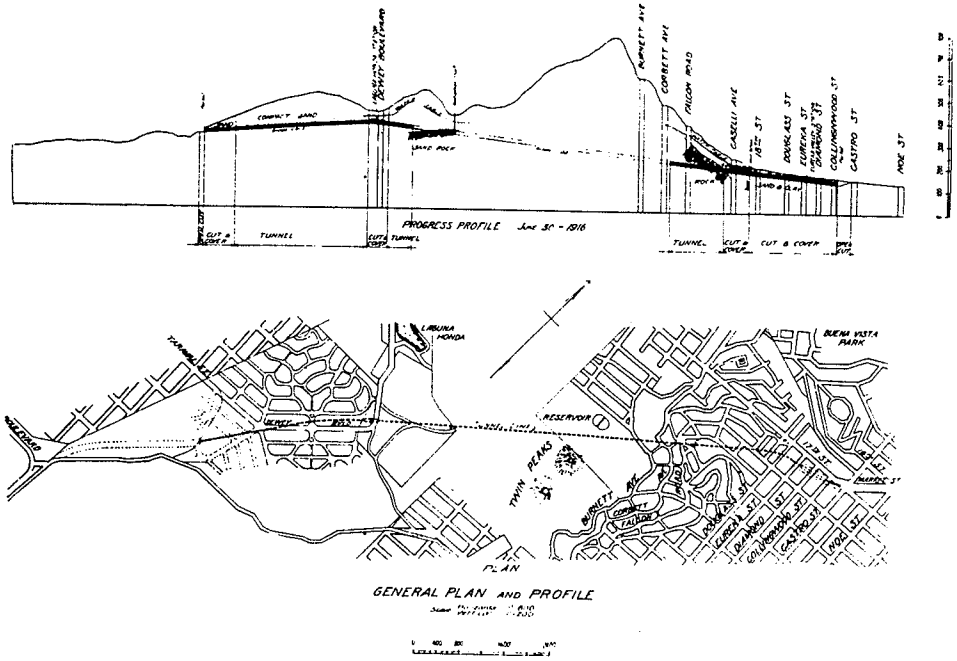
Constructing Laguna Honda Underground Station. The floor will be 62 feet below the ground surface.

Table II sets forth the progress made on these subdivisions during each of the two fiscal years just passed, and the work still to be performed. The profile pictures this progress:—

TABLE 11—ANNUAL PROGRESS.

Subdivision	Method	Station From	Station To	Lineal Feet — Completed Prior to June 1915	Lineal Feet — Completed June 30, 1915, to June 30, 1916	Lineal Feet — To be Compl.	Lineal Feet — Grand Total
West Approach	Open Cut	0+00	0+83	83			83
" Portal	"	100% completed					
Tunnel Section	Cut and cover	0+83	5+61	478			478
" "	In tunnel	5+61	8+10	249			249
	"	8+10	30+61		2251		2251
	Cut and cover	30+83	30+61		22		22
Laguna Honda		25%		*75			75
" " Sta.	"	55%			*165		165
" " "		20%				*62	62
Tunnel Section	Cut and cover	33+85	34+07		22		22
" "	In tunnel	34+07	39+00		493		493
" "	"	39+00	46+37			737	737
Vent Shaft	Cut and cover	10%		*2			2
"	"	90%			*18		18
Tunnel Section	In tunnel	87+63	46+57			4106	4106
" "	"	97+15	87+63		952		952
" "	Cut and cover	98+65	97+15		150		150
Taper Connect.	"	100+45	98+65		180		180
29′ 6″	"	100+75	100+45		30		30
18th Street Vent. Shaft		100% completed					
Subway Section	Cut and cover	111+46	100+75	1071			1071
Eureka Valley Station	"	114+46	111+46	300			300
Subway Section	"	117+38	114+46	292			292
East Portal	Open cut	100% completed					
East Approach	"	119+25	117+38	187			187
	Totals			2787	4283	4905	11,925

* Equivalent in feet.



SAN FRANCISCO

MUNICIPAL REPORTS

FOR THE

FISCAL YEAR 1916-17, ENDED JUNE 30, 1917

PUBLISHED BY ORDER OF THE

BOARD OF SUPERVISORS

SAN FRANCISCO
NEAL PUBLISHING CO., 414 MISSION ST.
1919

ANNUAL REPORT OF THE CITY ENGINEER
1916-1917

CITY AND COUNTY OF SAN FRANCISCO
Department of Public Works, Bureau of Engineering

San Francisco, December 6, 1917.

To the Honorable
The Board of Public Works of the
City and County of San Francisco.

Gentlemen: Herewith is transmitted the annual report of the Bureau of Engineering, for the fiscal year 1916-1917.

The development of the Boulevard System has been actively advanced during the past fiscal year. The Marina Boulevard, marked at intervals with gems preserved from the Panama Pacific Exposition, is now an assured fact. Camino del Mar has been extended into the Presidio, over an ornamental concrete viaduct constructed by the United States Government in co-operation with the City and County of San Francisco. The Esplanade has been extended as far as the limited appropriations for this improvement would permit. Twin Peaks Boulevard has been completed and Hunters Point military road is well under way. The last named thorofare will do much toward developing manufacturing industries in the southeasterly portion of the City, and will afford direct access to the Hunters Point dry dock and naval base, which the Government will construct in the near future. Plans have been developed for the Telegraph Hill Boulevard and the regrade of Rincon Hill. The policy of overcoming the defects of the rectangular street system in hilly districts has been pursued, and notable accomplishments in this direction have been the regrades of Cumberland, Noe and Sanchez Streets.

More pavements have been constructed within the past fiscal year than in any similar period since the memorable fire of 1906. A new type of pavement has been introduced, namely the so-called vertical fibre vitrified brick monolithic type. Its chief advantages over the older vitrified brick pavement for steep hillsides are its cheapness and ease of construction. Another advance in this line has been the adoption of "Topeka" surface, a semi non-skid sheet asphalt pavement. With the enormous urban automobile traffic of the present time, such a pavement has become a necessity. Six hundred and sixty-nine thousand, three hundred and sixty-five square yards of pavement of all types were laid during the past fiscal year.

The Municipal Railways, which, despite the pessimistic predictions of opponents of the system, have proven a great financial asset to San Francisco, have been developed along logical lines during the past year. The Church Street line has been completed and is earning dividends. The Twin Peaks Tunnel line will be completed during 1917, and a direct means of access provided before many months from the ferry to the districts beyond Twin Peaks.

On April 5, 1917, crews working on the east and west headings of Twin Peaks Tunnel met underground, 6,000 feet from the easterly portal. Shortly thereafter the bore was completed. It is conservative to predict that within a few years of its completion, property values to the south and west of the Peaks will advance in value in excess of the total amount paid for the construction of

the tunnel. Its construction will also facilitate providing adequate means of transportation to the towns down the peninsula, when adjacent communities see fit to become components of Greater San Francisco.

The principal units of the sewer system completed during the past year comprise an outlet for the west side of the Ocean View district; the Great Highway sewer, extending from Noriega Street to Lincoln Way; the Glen Park sewer extension; the Stanley Street sewer, and the Oakdale Avenue sewer. The system will be extended as additional funds become available.

On the Auxiliary Water Supply System, extensions have been provided in the Telegraph Hill district, in Pine Street and in First Street. The many frame dwellings on the steep slopes of Telegraph Hill have been afforded additional protection with an attendant reduction in insurance rates. The rock formation in this district made the excavation work costly. The other two extensions accomplished similar reductions in insurance rates.

The total number of surveys made during the past year were 1838. Two thousand six hundred and one precise levels have been run and bench marks established over a total distance of 180 miles. Fees for these surveys amounted to $24,712.

In the Testing Laboratory, 6004 tests were made on various structural materials, at a cost, inclusive of salaries and supplies, of $5529.40. The inspection of concrete paving base has been carried on with the aid of laboratory analyses with a marked increase in the quality of the resultant concrete. Analyses include the theoretical determination of the most economic cement and sand ratio—an exact result hitherto indeterminate, but which by continued research in our Testing Laboratory has been perfected.

Included in the report are maps showing population, area and assessed valuation of all districts of the City and County of San Francisco, and also the type of street pavement in each block thereof.

On the Hetch Hetchy project, construction work has continued interruptedly since my last annual report. The Railroad has been completed with the exception of a portion of the ballasting. The Lower Cherry River Power Development has progressed steadily and will be finished by about January 1, 1918. A reinforced concrete masonry buttressed arch dam is in progress of construction at Lake Eleanor. The design of this structure involves several original features—one is the placing of the central axes of the arches on a curved arc upstream across the present narrow channel of Eleanor Creek. Tangent to this central arc and extending to the abutments on each side of the present channel, the axes of the arches will lie in planes whose horizontal traces form an angle of 30 degrees. There are 20 arches, each with a span of 40 feet. About 7,000 cubic yards of high grade concrete will be embodied in the structure. Logging and yarding at the City's Canyon Ranch Sawmill for the season's run in 1916 amounted to over 1,600,000 board feet of rough lumber, besides a considerable quantity of surfaced material. During the spring of 1917, over 400,000 board feet were cut and planed. An additional sawmill has been established at Lake Eleanor. This has a capacity of 6,000 board feet per day. A base hospital has been designed and will be constructed at once. All branches of the work are well co-ordinated and advanced as rapidly as possible.

Following is a detailed description of the work accomplished in this Bureau during the fiscal year.

Respectfully submitted,

M. M. O'SHAUGHNESSY,
City Engineer.

TABLE No. 1.

POPULATION, AREA, AND ASSESSED VALUATION, BY ASSEMBLY DISTRICTS.

DISTRICT	POPULATION		AREA			VALUATION*	
	Total	Per Square Mile of Land	Square Miles of Land	Square Miles of Water	Total Square Miles	Land in Acres	Assessed Valuation of Taxable Land and Improvements
21	36,015	12,955	2.78		2.78	1,779	$ 89,321,280
22	19,746	2,816	7.00		7.00	4,480	11,639,750
23	32,919	6,330	5.20		5.20	3,325	11,441,380
24	36,888	4,822	7.65	†0.58	8.23	4,968	15,107,970
25	42,504	46,708	0.91		0.91	583	15,550,650
26	57,967	38,645	1.50		1.50	954	19,617,920
27	45,801	5,270	8.69		8.69	5,564	26,136,625
28	53,022	15,687	3.38		3.38	2,165	27,179,275
29	45,228	42,269	1.07		1.07	684	24,186,040
30	46,794	38,044	1.23		1.23	787	23,500,110
31	41,334	9,984	4.14		4.14	2,651	35,580,809
32	65,277	56,273	1.16		1.16	741	55,700,040
33	34,467	28,252	1.22		1.22	779	122,410,660
13	557,962	12,148	45.93	0.58	46.51	29,760	$477,372,509

* Assessed valuation for taxation is 50% of appraised valuation.

† Lake Merced.

BOULEVARD SYSTEM.

In advancing the policy outlined in previous annual reports of the City Engineer, work on the boulevard system has been actively prosecuted during the past fiscal year. The following is a description of the work accomplished.

MARINA BOULEVARD:

To have permitted the work of salvage to eradicate all trace of the Panama Pacific Exposition would have been a serious mistake, both from an economic and an aesthetic standpoint. Through the untiring efforts of the Exposition Preservation League, with which the City Engineer co-operated, if present plans are carried out, San Francisco is to have on the Exposition site a choice residential tract. This will be traversed by the Marina Boulevard and marked here and there with gems preserved from the Exposition, namely, the Column of Progress, the California Building, the Marina, Palace of Fine Arts, the Lagoon and the Yacht Harbor.

On the recommendation of this office, Pierce, Steiner, Francisco, Fillmore, Bay, North Point, Beach and Jefferson Streets were declared closed to permit the designing of a subdivision with roadways aligned in graceful curves, more in keeping with the natural attractions of the district than a gridiron street system.

The problems involved in planning the revised street arrangement were numerous. For example, the prevailing winds of the district could not be allowed to sweep along any main artery, and yet it was essential that certain remaining heritages of the Exposition be left visible as termini for properly framed vistas. The problem of proper distribution of traffic through the district was in turn complicated by the necessity of streets of changing direction while it was imperative that the maximum view frontage on the Golden Gate be developed.

The principal features of the plan which were finally adopted after more than a year's study were north and south axis centering on the Column of Progress and an east and west axis passing through the dome of the Fine Arts Building, both of which features will be recalled as ones that dominated their situation in the Exposition. At the eastern end of the east and west axis, centering on the Fine Arts dome, is a plaza approximately one acre in area from which a circular drive or boulevard distributes traffic to the secondary streets in the southern portion of the park. Courts have been planned at uniform intervals along the northern and eastern borders of the park in such a way as to create a succession of features along the two main boulevards while at the same time giving the maximum amount of view frontage looking on the Marina Park and the grounds of the Fine Arts Building. On the southern boundary two business centers have been created from each of which three arteries radiate to the main centers of the residence park.

It is proposed that the streets shall be paved and improved in the most modern manner and that all electroliers and other street ornaments shall be of special design. Public utilities such as gas, water and electric power mains will be installed underground. The plan incorporated some twenty odd plazas or parks at street intersections and includes eight or ten interior courts which will be devoted to recreational purposes.

On account of the reluctance of some of the property owners to enter into the scheme, the first section of the project only is now under process of resubdivision. This covers about one-half the area of the whole plot and requires the closure of about 870,000 square feet of existing streets laid out in the rectangular system and the opening of about 860,000 square feet of new avenues and boulevards.

Streets formerly traversing this area were uniformly sixty-eight feet nine inches wide, dividing the district into blocks of two hundred seventy-five feet in width by four hundred twelve feet six inches in length. The new streets vary in

width from one hundred feet for the Marina Boulevard with a roadway of fifty-one feet down to forty feet for the small intermediate streets.

To Mark Daniels, Consulting Engineer, who had charge of the work of resubdividing this district under the supervision of the City Engineer, much credit is due for the results obtained.

The Marina Boulevard passing along the northern boundary of the property is an important link in San Francisco's boulevard system, connecting the existing terminus at Fort Mason with a road to pass through the Presidio Military Reservation, a portion of which has already been constructed.

Skirting the northerly edge of the Marina Boulevard is the Belt Line Railway, of which the extension into the Presidio has been completed. The extension was urged by the Bureau of Engineering because of the military value of the track and the desirability of its being laid before construction of the boulevard was begun. As planned, the boulevard is free from railroad crossings and a schreen of shrubbery will extend between railroad and the north sidewalk.

Due credit must be given to the Pacific Gas and Electric Company, and the Sierra and San Francisco Power Company for the generous manner in which they co-operated in exchanging lands to open this boulevard between Fort Mason and the Presidio.

Twice bids were called so that the $30,000 appropriated in the last budget might be applied to the paving of the Marina Boulevard from Laguna to Scott Street, but in both instances the unit prices offered were too high and recommendations were made to reject the bids. Informal awards were made for the necessary fill along the boulevard. This fill was recently completed by day labor at one-third the cost of the amount set forth for that item in the formal proposals, thereby saving the City over $2,000.

As the route of this boulevard crosses the made ground in Harbor View and the Presidio, where the Exposition Company has pumped from the Bay 1,300,000 and 360,000 cubic yards, respectively, thereby reclaiming 184 acres, observations were kept to determine when complete subsidence had taken place so that street work, by undue settlement, would not be an economic loss to the City.

For the selection of Harbor View as the State Normal School site, the City Engineer actively co-operated, making three visits to Sacramento. Exhaustive investigations were made of the suitability of the existing California Building for a normal school and a report favorable on this location submitted to the State Legislature.

EL CAMINO DEL MAR:

With the $56,000 appropriated by the Panama Pacific Exposition Company, El Camino Del Mar, extending from Lobos Creek to Lincoln Park, over rights of way purchased by the City for $30,000, has been constructed under direction of the City Engineer.

The Federal Government and City of San Francisco jointly constructed a reinforced concrete viaduct over Lobos Creek as a continuation of this boulevard, and a stretch of road will eventually be laid extending northerly therefrom to meet the existing driveways in the Presidio. Over three years ago this boulevard was started by the City, but it was impossible for some time to secure the prompt co-operation of the military authorities for the immediate completion of the project.

The Honorable Congressman Kahn, with co-operation of Senator Phelan, finally succeeded in having appropriated for the government's portion of this work, $30,000. Contract for the viaduct over Lobos Creek was entered into in April, 1917, and is now 90% completed. An appropriation of $5,000 was made in the City's Budget for 1917-18 to meet the cost of completing the westerly 99 feet from the center of the Creek.

From Point Lobos to Fort Miley, Forty-third Avenue has been paved recently thereby supplying one of the few remaining links between the Marina and the Esplanade.

The three boulevard units, Camino Del Mar, the Marina and Presidio drives, which stretch across the north shore of the City, will, when completed, besides possessing military advantages afford many scenic attractions, enabling the pleasure seeker to obtain excellent continuous unobstructed views of the Bay, the Golden Gate and the Ocean.

ESPLANADE:

Few cities in the United States can boast of a more inviting stretch of seashore than that which extends from the Cliff House three miles southerly to Sloat Boulevard.

Plans have been made to provide proper shore protection for the entire distance against inroads of the sea and to pave and park the Great Highway permanently as befits the possibilities of this splendid driveway. Lack of sufficient appropriations has hampered these efforts, the net results to date being a 670 foot stretch of reinforced concrete esplanade bulkhead to withstand the ocean's encroachments. A request for an appropriation of $400,000 to extend the Esplanade to Lincoln Way was denied in the recent budget.

The finished section, constructed for the City under contract by J. D. Hannah, at a cost of $80,000, has occasioned widespread commendation and interest and many inquiries have been received for detailed plans from communities with similar problems, especially New York and New Jersey cities. The marked improvement presented by the bleachers and parapet of this structure over the brush grown embankment replaced, should insure an early appropriation of the funds for the remaining portion.

New grades have been established for the Great Highway from Lincoln Way to Sloat Boulevard. This boulevard will have two roadways; the lower, on the easterly side will be 40 feet in width with two sidewalks, and will serve the fronting property and intersecting streets. The upper roadway on the ocean side will be 90 feet in width with an additional 25 foot walk. A terrace or parked slope will separate the two roadways.

WIDENING OF SLOAT BOULEVARD:

The original plans adopted by the City Engineer for Sloat Boulevard from the Great Highway to Junipero Serra Boulevard, based upon future traffic needs, contemplated a 135 foot thorofare. This included a central space 35 feet wide to be occupied by the street railway, 30 feet of paved driveway on each side thereof, each adjoining 5 feet of parking and 15 feet of sidewalk. Present needs were accommodated with the south 30 foot paving strip, but the popularity of this drive with the ever increasing vehicular traffic caused negotiations to be hastened in order to complete the project as planned. Property owners along the north side of the present tracks have been prevailed upon to donate to the City sufficient frontage to make up the requisite 135 feet. The property was obtained by the City at no cost, contingent upon its starting the work by July, 1917. This has been done, the United Railroads having been persuaded to exchange its old right of way for the 35 foot central space, the City agreeing to pay the cost of removing and reconstructing the railway, the work of which is rapidly nearing completion. As soon as funds are available the northerly portion of the roadway will be improved providing for one way traffic on each driveway and minimizing the danger from collisions as well as greatly improving the appearance of the boulevard. The City Attorney's office is to be commended for earnest co-operation in this project.

SKY LINE BOULEVARD:

The route of the proposed sky line boulevard, lying in San Francisco county, starts at the City Hall and traverses thorofares already complete, to the intersection of Sloat Boulevard and Forty-first Avenue. Thence it will extend in a southerly direction, encircling Lake Merced, and continuing southward to the County Line.

On September 25, 1916, the Board of Supervisors adopted the following resolution:

> Whereas, There exists but one main highway from San Francisco along the peninsula into San Mateo and Santa Clara and Santa Cruz counties, which is rapidly becoming inadequate to meet traffic requirements, and the construction of an additional thoroughfare will soon become an imperative necessity, and
>
> Whereas, It is possible to provide for the construction of a boulevard along the crest of the hills separating the ocean and bay and Santa Clara Valley and thus affording a route unparalleled for scenic grandeur as well as provide traffic accommodations for a large extent of territory; therefore
>
> Resolved, That the City Engineer be requested to furnish the Board with the estimated cost of making a reconnaissance for a boulevard along the route stated; also
>
> Resolved, That a copy of this resolution be transmitted to the Boards of Supervisors of San Mateo and Santa Clara and Santa Cruz Counties with a request that they meet in conference with His Honor the Mayor, City Engineer and Street Committee of this Board for the purpose of considering the project herein outlined.

In response to the request contained in the foregoing resolution, a meeting was held at Redwood City on December 9, 1916, which was attended by representatives of San Francisco, San Mateo, Santa Clara and Santa Cruz Counties.

The project outlined was endorsed by the representatives present and it was resolved that the legislature be requested to pass an act that would provide for the construction of the proposed highway by the counties jointly interested with such assistance as might be rendered in connection therewith by the State of California and the Federal Government.

On May 5, 1917, the Legislature having passed the necessary Act (Chapter 52, Statutes 1917) another meeting was held in San Jose, likewise attended by representatives of the same counties. Endorsement of the project was again given and it was directed that the City Engineer of San Francisco, the County Surveyors of the several counties, and Professor C. B. Wing of Stanford University, make a reconnaissance of the route of the proposed highway and furnish an estimate of the cost of the same.

Pursuant to said direction the several County Surveyors, to-wit: James V. Newman of San Mateo, Irving L. Ryder of Santa Clara, Lloyd Bowman of Santa Cruz, Professor C. B. Wing of Stanford University and H. W. Swanitz, assistant engineer, assigned to this work by the City Engineer of San Francisco, on May 10, 11 and 12, 1917, accompanied by W. Lewis Clarke of the State Highway Commission, made a reconnaissance survey of the proposed route, beginning at San Francisco, following along the ridge between Bay and Ocean to the summit of Santa Cruz Highway, thence by Burrell Meyers to the head of Soquel Creek, thence by Corralitos Creek to Watsonville.

The route that I favor is from the City Hall, San Francisco, in a general southerly direction passing to the west of Merced Lake and thence down the the peninsula, following east of San Andreas and Crystal Springs Lakes to the summit of the San Mateo-Half Moon Bay Road, thence due southerly along the Castle Rock ridge to the summit of the Los Gatos-Santa Cruz State Highway, and thence to Santa Cruz and Watsonville along the State and County Highways: or leaving the main ridge at Saratoga Summit and following the divide between the San Lorenzo and Pescadero Creeks along the State Park Road to the Ben Lomond ridge. From there the road would follow the general direction of the Empire grade to Santa Cruz and thence by County Highway to Watsonville. or, continuing along the crest of the main range from the summit of the Los Gatos-Santa Cruz Highway via Burrell Creek to the head waters of Soquel Creek, thence over the divide to Corralitos Creek and down the same to Watsonville.

SLOAT BOULEVARD CIRCLE:

Anticipating the westward trend of development subsequent to the completion of the Twin Peaks Tunnel, the City Engineer devised a plan for co-ordinating at a common point of intersection the main thorofares south and west of Twin Peaks, named Junipero Serra and Sloat Boulevard, West Portal Avenue, connecting with the west portal of the Twin Peaks Tunnel, Portola Drive, which will connect with the Market Street Extension, St. Francis Boulevard, and the proposed entrance to the Spring Valley property. A satisfactory design has been worked out for the meeting of these boulevards to prevent congestion of automobiles and railway traffic and still give a scheme in harmony with the high class residential districts developed and planned for the future.

This plan provides a large circular space suitably parked, within which will be the heavy network of tracks and track special work connecting the tunnel line with the existing Sloat Boulevard and the Junipero Serra Boulevard tracts, and a future rapid transit line down the peninsula. Two purposes, aside from the aesthetic, will be served by this circle. The railway crossings will be minimized and auto drivers will be compelled to slow down to make the curve in safety.

Already neccessary property to the extent of nearly an acre has been acquired from the Westgate Park Company and Leopold Greene, for which voluntary assessments aggregating $13,125 have been levied on adjacent property owners. Construction work will be started in the near future.

Grateful acknowledgement must be made for the unselfish efforts of Mr. Duncan McDuffe and his landscape engineers, Messrs. Olmstead Bros. of Boston, for needed assistance in this project.

One of the conditions of the contract between Fernando Nelson and the Residential Development Company, for the purchase of the west portal tract, was that the former should deed to the City sufficient property to give a strip 32 feet wide from the west portal of the Twin Peaks Tunnel to the circle above described. This proviso was made part of the contract by Mr. A. S. Baldwin, of the firm of Baldwin and Howell, the original owner of this land, in order that an avenue of egress from the tunnel westerly might be provided for the municipal railway. An extract from this agreement follows:

> "I agree upon request of the City Engineer, M. M. O'Shaugnessy, to execute a good and sufficient deed to the City and County of San Francisco, of a strip of land not exceeding 32 feet in width for a right of way for railroad purposes, from the westerly portal of the Twin Peaks Tunnel to the westerly line of said 49.824 acre tract, it being understood that the City shall at its expense grade said strip of land to the level required for the operation of cars over the same, and that the City shall at its expense construct good and substantial concrete bulkheads along the northerly and southerly lines of said strip wherever said right of way shall be in cut, and with the further understanding that unless changed by mutual agreement between the undersigned and said M. M. O'Shaughnessy, the plan prepared by John M. Punnett, dated March, 1916, attached hereto, will in all respects be carried out by me except that I reserve the right to change the width and location of any of the proposed streets."

TWIN PEAKS BOULVEARD:

The Twin Peaks tunnel provides only for rapid railway transit, as it would have been both dangerous and uneconomical to include an automobile roadway. Ample provision has therefore been made to enable autos to cut down time and distance between the down town districts and the districts lying west of the Twin Peaks Ridge, by the construction of modern boulevards along the grades between these two sections of the City.

Four years ago, to reach the westerly portion of the City the auto truck or pleasure car was compelled to avoid the ridge by taking a circuitous northerly route over Haight or Fell Streets and Lincoln Way to 19th Avenue, or a southerly route over Valencia or Mission Streets and Ocean Avenue. Today a thorofare over Twin Peaks affords one of the most scenic boulevards in the world.

Starting at the intersection of Sloat and Junipero Serra Boulevards, the Portola Drive, completed in 1915, extends easterly on an ascending grade, through the fast developing modern residential parks of St. Francis Wood on the south, and West Portal tract on the north.

At an expenditure of $21,786.12, this driveway was extended last year along the route of the old Corbett Road to Twenty-fourth Street. This stretch, 4700 lineal feet in length, consists of a 20 foot paved strip of asphalt on concrete with 7½ foot shoulders, and is practically complete. As soon as possible it will be connected to the Market Street Extension, mentioned elsewhere in this report.

About 900 feet east of San Miguel Rancho, the Twin Peaks Boulevard connects with the Corbett Road. The upper boulevard thence ascends in a northeasterly direction by easy stages around the slopes of the Twin Peaks to an elevation of 830 feet, at which a figure eight loop encircles each of the peaks, the summits of which are about 80 feet higher. This work entailed an outlay of $57,075.77. Since its completion in November, 1916, it has been most popular with local motorists and tourists. From no other eminence in San Francisco can such a varied and pleasing panorama of ocean, bay, mountain and metropolis be obtained.

The link of this road just east of the figure eight was completed in 1916 at a cost of $26,907.97, and the adjoining stretch along Clarendon Avenue from St. Germain Avenue to Clayton Street, consisting of 1475 feet of pavement, 25 feet wide, and costing $7,732, was finished in the early part of 1917. Topeka surface was used here because the maximum grade was as much as 13 per cent. Descent from Clarendon Avenue may be made on the north by Buena Vista Boulevard and on the south by Seventeenth Street.

NEW PROJECTS.

OLYMPUS BOULEVARD:

In a desire to provide a more direct approach to Twin Peaks Boulevard by light grades, a drive 60 feet wide has been planned, starting at Fourteenth Street opposite Alpine Street and winding by easy curves into Park Hill Avenue, Masonic Avenue, Pluto Street, Lower Terrace, Seventeenth Street and Clayton Street, to a connection with Clarendon Avenue.

Agreements for obtaining the lands required to widen existing streets and for new diagonal streets through present blocks have been entered into during the last two years. Lack of funds has been the cause of delaying actual construction. However, since the major portion of the cost of Olympus Boulevard is to be obtained by assessing the property owners benefitted, the near future should see its completion.

MARKET STREET EXTENSION:

Nearly thirty years ago, in the era of cable traction, surveys were made for the extension of Market Street out to the Ocean Beach. This plan simply meant the prolongation of the City's main artery on its present alingment, irrespective of grades. This early proposition was abandoned, and when the problem was recently considered, a contour avenue was decided on.

To co-ordinate with this plan, in the design of Twin Peaks Tunnel a flat top subway section was adopted for the first 1800 feet, because of proximity of the street surface. To provide for a surface extension of Market Street, fee simple title was secured for a strip 90 feet wide and the 1800 feet along the line of the tunnel in Eureka Valley from Seventeenth and Castro Streets to Eighteenth and Hattie Streets.

The tunnel is completed and already the crossings of Diamond, Collingwood, Douglass, Eureka, and Ord Streets, where they intersect the tunnel right of way, have been reconstructed to conform to the planned extension. Specifications are being prepared for the paving of the boulevard between these crossings so that in a few months the City's chief artery will have been extended up to Eighteenth and Ord Streets. Surveys and plans have been made for a 70 foot right of way from this point up to Twenty-fourth Street and Corbett Avenue, where connection will be made to the existing pavement of Corbett Avenue. The maximum grade over this route is 9 per cent.

At the unanimous request of property owners affected, plans for this project are well advanced and it is hoped at an early date to have it ready for appropriate action by the legislative authorities of the City.

SAN BRUNO AND RAILROAD AVENUES:

The desirability has been recognized of relieving the congestion of traffic over Mission Street and the State Highway, the main southerly outlet into San Mateo County. The solution involved realigning, regrading and reconstructing the old San Bruno Road and Railroad Avenue to form the Bay Shore Boulevard. South of the San Francisco county line San Mateo has constructed an important link of this thorofare, connecting with the State Highway near Uncle Tom's Cabin.

Until recently the connection between San Bruno Avenue and Potrero Avenue was rough and unsightly. This has been corrected by extending Potrero Avenue from Twenty-fifth Street to intersect San Bruno Avenue, by widening the Ocean Shore Railroad Cut at Army Street and paving the entire distance. This involved over 20,000 cubic yards of excavation, at a cost of $35,546.94. The regrading of Railroad Avenue to meet additional traffic requirements, was described in my last annual report.

HUNTERS POINT ROAD:

As a war measure, last year the Federal Government appointed a committee to investigate and report on the suitability of various sites on the Pacific Coast for the location of a permanent naval base. Familiar with the unquestioned natural advantages of Hunters Point for the purpose, the City administration actively advocated its selection. Reports were prepared which showed that there is a water depth of 65 feet at the point and a deep water channel thence to the Ocean, whereas the other Bay sites considered have less than 20 foot depth, which is being decreased because of deposits of sediment from the San Joaquin and Sacramento Rivers. Assurances were given the Naval authorities that proper road facilities would shortly be constructed to make the site more accessible. While no official decision on the choice of a base has been published, it is understood that the Hunters Point site is favorably considered.

To reach Hunters Point, and to provide for existing and future industries

in this section, special endeavor has been directed toward the early completion of an 80 foot street with a 60 foot roadway, commencing at Railroad Avenue along Evans to Ingalls, thence diagonally through land acquired from the Water Front Land Company to Hawes near Hudson Street, thence along Hawes from Hudson to Innis, thence along Innes from Hawes to Donohue, thence along Donohue, Innes to Galvez, thence along Galvez, Donohue to Coleman, thence through City property diagonally from Coleman and Galvez to Boalt Street and Fairfax Avenue, thence along Fairfax from Alvord to Boalt and along Alvord, Evans to Fairfax, to the existing dry dock of the Union Iron Works on this point, a distance of 2¼ miles. This work involves 91,427 cubic yards of excavation and 101,876 cubic yards of fill, besides curbs, sewers and 637,669 square feet of pavement with 6 inch concrete base and 2 inch asphalt wearing surface. Two acres of property are to be acquired.

The cost will be about $225,000, part to be borne by the Union Iron Works and the City and fronting property owners to pay the remainder. About three-fourths of the entire length is under contract. Nearly 90 per cent of the necessary property has been acquired and as soon as the remaining portion has been deeded to the City, contracts will be awarded for the remaining construction.

The completion of this project will have the effect of opening up two miles of deep water frontage heretofore inaccessible.

TELEGRAPH HILL BOULEVARD:

By proper landscape treatment Telegraph Hill can be made an attractive eminence instead of a quarry scarred obstruction to traffic. The first requirement is a suitable avenue of approach to the summit. Four schemes have been evolved, each of which contemplates a roadway 24 feet wide and a 6 foot sidewalk with a protecting railing. The initial point of the various schemes is as follows:

(1) Northeast corner Kearny and Broadway; (2) Northeast corner Montgomery and Broadway; (3) Just west of Washington Irving School in Broadway; (4) Northeast corner of Sansome and Vallejo Streets.

The terminal at the upper end, Lombard and Sansome Streets, is common to all plans. The property in the last two blocks along and adjacent to the boulevard is to be retained for park area as an addition to Pioneer Park. City property in the vicinity will be utilized where practicable. Any scheme adopted embraces a reinforced concrete viaduct about 300 feet long between Lombard and Greenwich Streets. Schemes No. 3 and 4 include an additional viaduct across Green Street.

Maximum grade, length and estimated cost of construction of the four schemes is as follows:

Scheme	Length in Feet	Maximum Grade	Est. Cost of Const.
1	2800	8.5%	$154,000
2	2500	10%	140,000
3	2450	10%	142,000
4	2200	8.2%	135,000

REGRADES:

Most of the area of the City and County of San Francisco has been subdivided on the right angle block system, with no thought whatever for the contour of the ground or steepness of the grades, many of which are as high as 40 per cent. In altering such grades, existing improvements must be considered, many lots having already been built upon, and each property owner desirous that the grade fit these improvements.

The modern subdivision with its contour streets and easy grades is eliminating this evil. On the ungraded streets which are too steep for vehicular travel, it is found desirable to park the majority of the street and construct easy stirways.

An example of such treatment is on Day Street between Castro and Diamond Streets, Greenwich Street between Kearny Street and Grant Avenue, which has never been graded, is built upon both sides with many permanent structures. Special treatment, such as shown on attached program is necessary to obviate raising or lowering every building on the block.

Liberty Street between Church and Noe Streets and Sanchez Street between 20th and 21st Streets are similar to those above mentioned inasmuch as they are ungraded, built upon, and have very heavy cross warps.

On these streets it is found advantageous to design an upper and lower roadway with parking space and walls between, and to open two new streets so that vehicles can travel in a southerly and westerly direction to Noe Valley.

Money for the acquisition of the property necessary for the above projects has been included in the 1917-1918 budget and the City Attorney has commenced action to acquire it.

In the past year grades have been changed, established and investigated as follows:

Grade changes—333 blocks, 159 crossings	24	miles
Grade establishments—109 blocks, 50 crossings	6½	miles
Investigations—138 blocks, 55 crossings	10	miles
Total	40½	miles

A number of other streets where special treatment in grades have been made and which will be improved in the near future, are:

Carolina Street between Twenty-second and Twenty-third Streets.
Lyon Street between Broadway and Vallejo Streets.
Alvarado Street between Castro and Diamond Streets.
Missouri Street between Twentieth and Twenty-second Streets.
Douglass Street between Twentieth and Twenty-first Streets.

The area lying south of Howard Street and east of Third Street comprising about twenty city blocks on an elevation known as Rincon Hill, in former days one of the choice resident districts of San Francisco; but this hill formed a natural barrier to the main lines of traffic between a mile of waterfront docks and freight terminals and the area dependent upon them, comprising the general industrial district and the business center of the City. Its proximity to the waterfront and the railroads is the cause of the development of this section from a residence district to an industrial and warehouse center.

The Chamber of Commerce made some preliminary studies of Rincon Hill in 1912 with a view to suggesting a scheme for its regrading.

This office has made a comprehensive study of the problem and evolved several improvements on the original schemes presented.

It was found that with a reasonable amount of excavation gradients could be established having a maximum of 2 per cent for north and south streets and 4½ per cent for east and west streets. With these street grades established, every piece of property east of Second Street and south of Folsom Street could be reached by a projected system of railroad spur tracks terminating in the main Belt Railroad system. Modern motor trucks could easily make the maximum grades on the east and west streets. The hill would no longer be a barrier to heavy traffic and about 46 acres of land with practically no earning power could become a potential income bearing property worth from two to five times its present value.

About 90 per cent of the existing improvements upon the property in this district are wooden structures, many of them obsolete, and the owners would welcome an opportunity to replace them with a more substantial type of building. The present condition of the property makes it very difficult for the owners to negotiate loans for any improvements. It was found that the cost of improving

the streets could not be sustained by the adjoining property. Close study of the problem shows that the owners of this property would not by any means be the sole beneficiaries by improvements contemplated, but that a very large metropolitan area would be materially benefitted. To effect maximum economy it is desirable to grade and make all of the improvements in this area, as one project centrally controlled. Before this can be done, certain changes in the assessment laws for local improvements must be enacted.

The following is a tabular resume of the principal elements in the Rincon Hill regrade project:

Estimated cost of street work including 1:1 slopes	$1,500,000
Estimated cost of grading private property and restoring improvements	$2,500,000
Present average assessed value private property (60% of full value)	$ .76 sq. ft.
Full value on same basis according to 1916 assessment	$1.25 sq. ft.
Average estimated value after improvements	$2.50 sq. ft.
Permissible to spend for improvement to private property	$1.25 sq. ft.
Area of proposed reduced district	2,000,00 sq. ft.
	46 acres
No. parcels of property involved in regrade	277 parcels
No. city blocks involved in regrade	13 city blocks
Estimated cost of grading private property and restoring improvements not incl. 1:1 slopes	$1.25 sq. ft.
Total yardage of materials to be removed	3,386,000 yds.
Time required for removing hill estimated at	3-4 years

BERNAL CUT:

The bulk of the materials used for street and home improvements in new subdivisions beyond the Twin Peaks Ridge was conveyed via Mission Street and Ocean Avenue or over Fell Street and Lincoln Way. The grades and length of the former route added so much to the cost per ton mile that the proposed Bernal Cut could have been built for the saving it would have had effected to date.

One of the conditions made part of the agreement for the Southern Pacific Company's new franchise at Third and Townsend Streets was that the City should be given a right of way through the existing Bernal railway cut from Randall Street to San Jose Avenue, the Railway Company to do the necessary grading to accommodate the paved roadway.

With the rapid growth of our Municipal Railway System, the extension through this cut of the Church Street Line from 30th Street to supply needed traffic facilities to the Sunnyside and Ocean View Districts, was planned, and in order to provide for the street railway, as well as vehicular and pedestrian traffic, steps have been taken to acquire a wider roadway through the cut than that provided in the original agreement. Surveys and plans for this improvement are complete and necessary lands are being acquired.

This work involves the extension of Dolores Street to the existing Southern Pacific right of way at Randall Street, the removal of 232,000 cubic yards of excavation and placing 95,500 cubic yards of fill, the removing and reconstructing of the Southern Pacific tracks to the west side of the widened cut, the paving of a 42 foot roadway and construction of an 8 foot sidewalk with necessary retaining walls on the east side of cut throughout the 4,450 feet of length. The cost will be approximately $650,000, exclusive of the grading to be done by the Railroad Company.

CUMBERLAND STREET, NOE TO SANCHEZ STREET:

The regrade of Cumberland Street between Noe and Sanchez Streets and Sanchez Street between 19th and 20th Streets has been completed. Persistent

efforts to reconcile the diversified opinions of the people of this district and obtain their agreement to the most logical plan, finally were successful.

Existing street improvements leading to this section, the abrupt nature of its topography and the fact that fronting owners had proceeded with their home building with an utter disregard for any grade plan, injected complications into this problem, requiring the application of some engineering ingenuity for solution.

Sanchez Street at 19th Street was graded and paved while 50 feet south the ground was 16.5 feet higher. Cumberland Street at Sanchez Street was graded and paved while 20 feet west the ground was 31 feet higher. Sanchez Street at Cumberland Street was improved with an elevation at the northerly line of 198.83 and at the south line of 209.17 whence the ground rose sharply to an elevation of 240 feet. Twentieth Street at Sanchez was an improved street having an elevation of 240 feet the east side of Sanchez Street conforming to official grade, while the west side was 25 feet higher.

The only inlet adaptable to changes that would permit of vehicular traffic was via Twentieth Street. This will also serve the district south of Twentieth Street between Church and Noe Streets. By a system of retaining walls and stairways, pedestrians may reach this region at Sanchez and Nineteenth Streets, Cumberland and Noe and Cumberland and Sanchez Streets. The general street design of roadways and walks in the same plane was precluded here, the difference in elevation between houses on opposite sides of the street being from 7 feet to 19 feet. To keep at a minimum the height of retaining walls, at the property line on the high side and still not leave the homes on the low side in a hollow, the space between curbs was designed with elevated or depressed sidewalks and terraces. These terraces vary from level parking spaces to sloped surfaces having a pitch of 10 feet in width of 11 feet and 13 feet, according to ground conditions. As planned, the majority of retaining walls did not exceed 6 feet in height. Three were constructed at a maximum height of 12 feet. In some instances where the fronts of the houses were back of the property line, the terraces were extended into the property thereby doing away with necessity of a wall. A 2½-foot cross warp in the roadway, was resorted to to cut down heights of walls.

Sanchez Street from Twentieth to Cumberland Street is paved with 2 inches of asphalt on a 6 inch concrete base descending on a 5.3 per cent grade. The crossings of Sanchez and Cumberland Streets is similarly paved. From the north line of Cumberland to 89 feet northerly, the grade of Sanchez Street is 16.6 per cent and thence to Nineteenth Street it is 28 per cent except the parking space and wall where the grade is lessened to permit vehicles to turn. Hillside brick pavement was used where grades were sufficient to warrant the increased cost.

On Cumberland Street west of Sanchez Street a 9.5 per cent grade obtains for 155 feet, a 4 per cent grade for the next 100 feet and a 15 per cent grade for the remainder to Noe Street, except around the island park at Noe Street where the grade is reduced to allow traffic to turn.

Concrete in walls and stairs was a 1-2-4 mix delivered from mixer to forms by gravity chutes. Six inch tile drains imbedded in broken rock were placed back of all walls and concreted to weep-holes at proper intervals.

Galvanized iron railings are placed on walls where necessary. Special fittings had to be cast for all this work on account of the many curves and breaks in grade. Hardly any two fittings were alike.

Excavation was performed by a ¾ cubic yard steam shovel except at Sanchez and Nineteenth Streets where the steep grade made the use of the shovel dangerous. Here a trap was erected and 4-horse Fresnoes scraped the material into chutes which led into the trap, whence it was loaded into motor trucks. Over 20,000 cubic yards loose measurement was handled in this manner.

Now that this section has been made accessible and that these streets present an inviting appearance, the wonderful view to be obtained from this height, the ideal climatic conditions existing there, and the proximity of the Church Street

Line of the Municipal Railway System, will all be potent factors in inducing people to locate. Property enhanced substantially beyond its original value since the improvement was assured.

LEAVENWORTH STREET AND CHESTNUT STREET:

Francisco Street between Hyde and Leavenworth Streets at an elevation of approximately 130 feet before the recent improvement of Leavenworth Street between Chestnut and Francisco Streets, has been practically inaccessible. The only approach thereto, over Hyde Street between Chestnut and Bay Streets was on a 20.5 per cent grade with a very dilapitated cobblestone pavement.

A few years ago new grades were established to provide a convenient approach to this district. The first unit of this improvement was completed in December, 1914. This consisted in part of a retaining wall swinging from near the middle of the south line of the crossing of Francisco and Leavenworth Streets to the north curb at the west line and a stairway on the northeast face of the wall leading from the upper to the lower levels of the crossing. As then finished, ready ingress and egress was afforded pedestrians, but a second unit of this work had to be installed to accommodate vehicles. This consisted of the continuation of the existing retaining wall southerly in Leavenworth Street parallel to the property lines for a distance of 187.5 feet dividing the street into two levels. The new grade of upper Leavenworth Street follows closely the old San Francisco Road which in early days led from the heart of town to Black Point.

When completed the 68.37 feet width of Leavenworth Street will be divided into a 10 foot walk on the east and a 6 foot walk on the west side with roadway of 52.37 feet wide extending from Chestnut Street northerly to the end of the retaining wall where it divides into an upper drive of 17.5 feet wide and a lower drive of 32 feet wide. The grade from Chestnut Street to the dividing wall and 50 feet northerly on the lower portion of the street descends at 15.9 per cent and then at 6.8 per cent to the crossing of Francisco Street. The upper roadway ascends northerly along the east face of the wall on a 3.4 per cent grade. The street is paved with 2½ inches of asphalt surface on a 6 inch concrete base except on the 15.9 per cent grade where hillside brick are laid on a 1½ inch sand cushion on a 4 inch concrete base.

The heavy portion of the excavation, 5,800 cubic yards was done by steam shovel. To insure against undue settlement in the fill back of the wall, special precautions were taken in tamping. The fill, placed by wheelbarrows, was water tamped, the weep holes in the wall having been temporarily plugged to hold the water and all pulled simultaneously to give a uniform settlement. The subgrade was rolled with 5-ton motor trucks empty and then loaded.

The wall of reinforced concrete of the cantilever type surmounted with a 4.25 foot parapet is 31.25 feet high at one end and 5.75 feet at the other. Exclusive of the base and parapet, it is 12 inches thick at top and batters 7 inches to 5 feet of depth giving a maximum base thickness of 3.86 feet at the highest section.

A 20 inch high pressure pipe, one of the main feeds from the Fort Mason Pumping Station which has been constructed in tunnel, was uncovered along the east edge of the toe of the wall.

BRIDGES

THIRD STREET BRIDGE:

The Third Street Bridge was rewired and a new submarine cable was installed under contract awarded to the Butte Engineering & Electric Company on August 24, 1916. The work was completed and accepted on June 25, 1917, and cost $3,874.

The laurel wood floor surface placed two years ago is making a record for service, being still in very good condition. Ordinary pine flooring formerly used had to be replaced three times during each year.

The south abutment, disturbed at the time of the earthquake in 1906, continues to move northward at a decreasing rate, being about one inch during the last 12 months, as against two inches per year prior to that time. The movement this year has been taken up in the structure with minor alterations and adjustments made possible by the work done last year. Despite the opening of the Fourth Street Bridge traffic on Third Street Bridge continues heavy. During rush hours eighty street cars and over two hundred vehicles per hour cross the structure.

FOURTH STREET BRIDGE:

On June 25, 1915, the Thomson Bridge Company was awarded the contract for removing the old swing draw bridge and for constructing a modern Strauss Trunnion Bascule drawbridge at Fourth Street, crossing the channel.

The foundation for this bridge was designed in this office and the superstructure was designed by Mr. J. B. Strauss of Chicago, patentee of this type of bridge.

The bridge proper is a single leaf, through span of 94 feet counterweighted on the north side with a 700 ton overhead concrete weight spanning the roadway.

The bridge roadway is forty feet wide and is paved with creosoted wood blocks. Provision has been made for the installation of street car tracks should they be required at any time. There are two 6-foot sidewalks on the outer side of the trusses for pedestrians.

Operating power is furnished by electric motors housed on the north side. The operator's house is over the west motor housing and commands a clear view. Opening to the full vertical position can be effected in approximately one minute after giving the warning alarms. A clear waterway of 75 feet for the passage of vessels is obtained with the structure raised. The channel was dredged to elevation minus 35 feet, City base, which enables vessels of 20 foot draft and fifty foot beam to pass the opening safely.

This improvement cost $89,672.09 and was finally accepted on May 23, 1917.

STREET PAVEMENTS

More permanent pavements have been constructed within the past fiscal year than in any other year since the memorable fire of 1906.

A new type of permanent pavement adapted to light traffic and residential streets was introduced here, namely the so-called vertical fibre vitrified brick, a monolithic type of pavement. This has been in use for the last three years in the middle west and has given satisfactory results. Its chief advantages over the older vitrified brick pavement are its comparative cheapness and ease of construction. A service test of at least ten years will be required, however, before its permanency can be established beyond question. Should this pavement prove entirely satisfactory and be permanently adopted, its selection will affect a saving of from 15 per cent to 20 per cent over the old standard brick pavement.

Another advance in pavement construction has been made in the adoption of "Topeka," a semi-nonskid sheet asphalt pavement. This pavement is particularly suitable to streets that have a gradient in excess of that which ordinary sheet asphalt can be used, but on which a comparatively smooth pavement is required. In general, on residential streets of medium grade Topeka surface can be used in place of the ordinary asphalt pavement. With the enormous urban automobile traffic of the present time, a pavement having pronounced nonskid properties becomes a necessity.

Topeka surface has been used extensively in the construction of streets in Westwood Park and other recently developed residential tracts. It has also been

used on the northerly end of the Twin Peaks Boulevard, and on the first unit of the Market Street extension adjoining the east portal of the Twin Peaks Tunnel, and probably will be used upon the entire boulevard. The fact that this pavement has stood up on the State Highway in San Mateo County for four years under the tremendous pounding of Sunday traffic amounting to 15,000 machines of all types, is proof that it will wear well in San Francisco under less severe conditions. Our experience with asphalt has proven that the successful street pavement of the future will be of less thickness than formerly and will possess greater nonskid properties, 90 per cent of the traffic now being rubber tired.

One of the greatest difficulties encountered in the planning of street pavements is that of procuring proper surface drainage, with the improvements and grades often permanently established. Especially is this the case on thorofares having nearly a flat grade. The addition of too many catchbasins is both costly as well as unsightly. It was for this reason that this office recommended the adoption of vitrified brick gutters in connection with asphalt pavements on such streets, it being possible to construct this type of gutter with a flatter gradient and an individual transverse slope, thereby preserving a uniform cross-section on the main moving-traffic portion of the roadway.

Within the last fiscal year many special projects in the way of street improvement had to be handled by this department and, working plans for the Contractor prepared. To expedite the work of planning some of the more difficult of these, paper forms were made to scale showing the proper crowns and section. These were put in skeleton form and modified when necessary. Plaster of Paris was poured over modeling clay rough shaped to the finished contour and the whole finally smoothed down to the finished grade. This was found to be an excellent way of visualizing the improvement and brought out forcibly small irregularities in design that might otherwise have been overlooked.

Nearly all of the many miles of track reconstruction handled by the United Railroads within the year, and all street reconstruction handled by the Street Repair Department was constructed on the grades worked out by this office.

AMOUNT AND COST OF STREET WORK—PRIVATE.

Fiscal Year ending June 30, 1917.

	Quantity, Sq. Yds.	Cost
Asphalt (6" Concrete Base):		
W. S. 1½" Binder 2"	1,175.11	$ 2,644.00
W. S. 2 "	223,195.66	454,757.27
W. S. 2½"		
W. S. 1 " Binder 1½"	373.37	873.68
Bituminous Rock (6" Concrete Base):		
W. S. 2"	17,524.32	38,423.35
Basalt Blocks:		
Gravel and asphalt filler on sand	14.00	45.36
Gravel filler (6" concrete base)	349.28	1,336.27
Cement filler (6" concrete base)	3,506.81	8,801.94
Vitrified Brick:		
Kiln marked or hillside	4,101.47	14,355.75
Asphalt with Basalt Block Strip:		
Asphalt W. S. 2"	1,063.22	4,246.92
B. B. with gravel filler	490.00	1,848.50
B. B. with gravel and asphalt filler	305.00	1,193.36
Asphalt with Vitrified Brick Strip:		
Asphalt W. S. 2"	81,366.54	169,868.13
Brick, kiln marked or hillside	29,902.96	103,234.74
Broken rock	2,664.66	1,560.00
Cobbles	480.72	1,081.62
Total	366,513.12	$804,270.89
Curbs:		
Granite, new—lin. ft.	14,582.70	17,303.38
Granite, reset	1,263.91	226.58
Concrete	139,958.90	105,412.02
Gutters:		
Basalt Blocks—sq. yds.	325.28	1,228.49
Walks:		
Artificial stone	9,474.85	9,122.64
Grading:		
Cut	95,426.00	53,439.50
Fill	45,292.00	23,552.03
Total	140,718.00	$ 76,991.53

MUNICIPAL RAILWAYS.

CHURCH STREET LINE:

The Church Street Line of the Municipal Railway commenced operation on the 11th of August, 1917. The placing of this road in operation marks the completion of the final link of the extensions contemplated under the Bond Issue of 1913, when the citizens of San Francisco voted $3,500,000 for extending the Municipal Railway System by the construction of some 12 miles of double track and the purchase of the Presidio & Ferries Railroad or the so-called Union Street Line comprising 3.78 miles of double track.

In the last Annual Report of the Bureau of Engineering there was presented in detail a chronology of the public proceedings had in connection with the construction of the Church Street Line, so that it is sufficient here but briefly to touch upon this earlier history.

The Church Street Line contemplated under the provisions of the Bond Issue consisted of an extension of the Municipal Railway System from Van Ness Avenue and Market Street, out Market Street to Church and over Church Street to 30th Street. For a number of reasons, in constructing this road, it was considered necessary to divide the line into three sections:

Section "A" from Van Ness Avenue and Market Street to 16th and Church Streets; Section "B" from 18th and Church Streets to 22nd and Church Streets; and Section "C" from 16th and Church Streets to 18th and Church Streets and from 22nd and Church Streets to 30th and Church Streets.

Section "A" included that portion of the line in which it was anticipated that legal difficulties and obstacles would be placed in the City's way by the United Railroads. Section "B" covered that portion of the road where a diversion was made from Church Street through Mission Park and a private right of way which involved the acquisition by condemnation or purchase of a large number of small parcels of land, and Section "C" comprised that portion upon which no unusual conditions existed.

Section "C" was completed April 29, 1916. Section "B" was completed June 28, 1916, and Section "A," the last link to be finished, was completed on the 1st of August, 1917.

This latter contract was awarded to the Western Motor Drayage Company on the 16th of March, 1917. The completion of this contract was contingent upon the delivery of the track special crossings of manganese steel which had to be manufactured and delivered from the East, after the last legal obstacle in the way of the construction of the line had been removed.

In order to expedite this work to the fullest degree, this office had prepared the necessary plans and specifications and the Board of Public Works had advertised for bids and entered into a contract with the United States Steel Products Co. for the delivery of these special track castings within 90 days after the receipt of the order. This arrangement in effect gave the City an option on this material, which was to be exercised in the contingency of a favorable decision from the United States Court, to which the United Railroads had appealed for an injunction to prevent the construction of parallel tracks on Market Street and on Church Street.

On January 18, 1917, Judge Wm. H. Hunt, of the United States District Court handed down a decision of the most momentuous import to our Municipal Railway System. In his decision, in which he denied the injunction sought, he stated:

> "It is accepted that the destruction of the franchise is not possible, but even so, in the complexities of modern society new conditions present themselves which may call for the safeguarding of the public interest in a way which justifies the application of the doctrine that the police power may extend to all great public needs."

And further:

> "There being no statutory rule against one street railway company from crossing the tracks of another, I do not find that compensation must first be paid for the crossing."

In his opinion, he quotes, from the case of the Consolidated Traction Company vs. the South Orange and Maplewood Traction Co., in which the Court held that.

> "Although the crossing necessitates some actual interference with tracks as constructed and to some extent changes thereafter the exclusive use by the one company of its crossings, still such changes are the necessary result of the development of the method of operating electric roads at their points of crossing, and are such as are made necessary as the best and safest methods now attainable for the safety and convenience of the public in the operation of both roads at the point of crossing: that they are changes and burdens in the use of its tracks and trolley system to which the original right to lay and construct them was necessarily subject."

Immediately upon the receipt of Judge Hunt's decision the United States Steel Products Company was ordered to proceed with the manufacture of the crossings for Section "A" of the Church Street Line. While these crossings were being manufactured, the specifications were prepared and bids advertised for the construction of the track work on this section and also for the erection of the poles and overhead electrical work.

In connection with the question of poles for this section of the line, this office took up with the United Railroads the question of entering into an agreement with that Company for the use of the existing poles on Market Street and on Church Street in order to avoid the unnecessary duplication of poles on these streets, suggesting as a basis for the agreement the so-called Joint Pole Agreement which is in effect between the various public service corporations of the City, under which any company is allowed to use the poles of another corporation by paying the proportional cost for the pole, or other equitable arrangement. This the United Railroads refused to do, whereupon the City entered into a contract for the erection of a second set of poles on Market Street from Van Ness Avenue to Church Street and on Church Street from Market to 16th Street. While these poles were being manufactured, but before they were placed in position, the Chairman of the Public Utilities Committee, Supervisor Edward I. Wolfe, appealed directly to Mr. Lilienthal, President of the United Railroads, to reconsider his objection and allow the City to use the United Railroads' poles. Mr. Lilienthal, after further review, yielded and the Contractor was directed not to set the poles.

After the award of the contract for the construction of Section "A," when the Board of Public Works requested the Supervisors to appropriate the amount of the contract, an effort was made by individuals representing different interests to effect an agreement between the City and the United Railroads, which would obviate the necessity of constructing these additional tracks on Market Street. The consideration of these questions by the Board of Supervisors consumed several weeks before they decided to proceed with the construction of outer tracks from Van Ness Avenue to Church Street, but with the expressed intention of a number of the members of the Board that the further construction of tracks on Market Street, that is, between Kearny Street and Van Ness Avenue and between Church Street and Castro Street, would not proceed until further effort had been made to reach an agreement looking to the use of the United Railroads tracks on this portion of Market Street.

TWIN PEAKS TUNNEL LINE:

R. C. Storrie & Co., who have the contract for the construction of the Twin Peaks Tunnel, completed their work early in July, 1917, and the 14th day of July was set as the day to celebrate the completion of the Twin Peaks bore. At the completion of the dedication ceremonies the construction of the railway through the Twin Peaks Tunnel will be commenced.

The contract for the construction of the railway through the tunnel was awarded to Eaton & Smith for the sum of $80,467.25. This contract is for double track overhead electric railway from East Portal of Twin Peaks Tunnel near Castro Street, through the tunnel, and over West Portal Avenue to the junction of Sloat and Junipero Serra Boulevards. The trolly wire, rails, ties, tie plates and other track material for this work are being furnished by the City, having been purchased under contract over a year ago, in order to assure their being on hand when the work was ready to commense.

The type of track to be installed through the tunnel is what is known as ballasted open track construction. The rails weigh 70 pounds per yard and are in 60 foot lengths through the tunnel. This longer length of rail was adopted for use in the tunnel to secure smoother, quieter operation by the reduction of the number of joints. The longer length rail has the further advantage of reducing the cost of maintainance and of bonding. This length of rail is not generally adopted for railroad construction in the open as the allowance at the joints to care for expansion due to temperature changes in exposed work becomes excessive. This objection does not hold in the tunnel, where there will be comparatively small temperature changes, permitting the joints to be laid close.

The type of overhead trolley work is what is known as the catenary suspension type. In this construction as adopted the trolley wire is supported at 12 foot intervals from a separate steel cable ⅜ inch in diameter, which is stressed in tension to approximately 1800 pounds. The frequent points of support maintain the trolley wire at practically a uniform elevation above the track, thereby avoiding the sparking and wear found at the points of support in the ordinary type of construction. This will also in a large measure reduce noise in the tunnel by eliminating any rigid connection between the trolley wire and the suspended ceiling in the tunnel.

The construction of this Twin Peaks Tunnel line will be completed on or before December 1, 1917, and it is hoped that by the time it is completed some solution will be had for operating cars directly down Market Street and connecting with the existing lines west of the Twin Peaks.

The schedule time for cars through the Tunnel will be 6 minutes and 23 seconds eastbound, and 7 minutes 16 seconds westbound, allowing for stops at both stations.

The running time of the United Railroads cars from 17th and Market Streets to the Ferry at the present time is 20 minutes. If outer tracks are constructed on Market Street to Kearny Street this time will be reduced at least 3 minutes. This will make the running time from Sloat Boulevard to the Ferry 26 minutes, or about 20 minutes less than the time now required.

FOUR-TRACKING MARKET STREET:

When the routes for the extension to serve the Exposition were determined upon prior to the bond election of 1913, the City Engineer realized that there would be serious opposition encountered to the construction of tracks on Market Street from Van Ness Avenue to Church Street. To guard against this the enacting ordinance was so framed as to permit a suitable connection from Van Ness Avenue and Market Street to Church Street, it being in mind, in event of an adverse decision of the Courts, that this connection could be made by leaving Market Street after five blocks.

This Department made an effort to start the construction of this section of the line first, in order that the legal difficulties might be met and solved in advance of constructing the remaining portion of the work. This idea met with the opposition of certain members of the Board of Supervisors who desired to have the plan for overcoming the grades on Church Street adopted first. The result of this departure from the Engineer's recommendation was to have Section "B" and "C" of the Church Street road, that is, the portion south of 16th Street on Church Street, completed and lying idle for one whole year awaiting the determination of the City's right on Market Street.

After the above condition was created, this Department evolved a plan under which, by a temporary transfer agreement made with the United Railroads, the Church Street Line could be operated from 30th to Market Street. This temporary transfer agreement was rejected by the Board of Supervisors and upon the United Railroads refusing to allow a connection to be made with their tracks at 16th and Church Streets, after having agreed to sell to the City a one-half interest in those tracks on Church Street, the Board of Supervisors passed a resolution directing the Board of Public Works to proceed with the construction of outer tracks on Church Street from 16th to Market Street and on Market Street from Church Street to Van Ness Avenue. The Supervisors further, by resolution, directed the Board of Public Works to prepare plans for the construction of outer tracks on Market Street from Kearny Street to Van Ness Avenue and from Church Street to the East Portal of Twin Peaks Tunnel. Thereafter in order to bring the matter into the Courts and secure the earliest possible decision as to the City's rights on Market Street, upon the recommendation of the City Engineer, the Board of Public Works adopted a resolution authorizing the City Engineer to construct outer tracks on Market Street and Church Street by day labor. Immediately following the passage of this resolution work was commenced at the intersection of Van Ness Avenue and Market Street to install a crossing in the United Railroads tracks. On the following day an injunction was served on the Board of Public Works and the City Engineer restraining them from further work on this construction, and on August 22nd, 1916, Judge Wm. H. Hunt, United States District Court, commenced the hearing of the case, which hearing was completed on the 25th of August. On the 18th of January, 1917, as noted before, a decision favorable to the City was returned. As before referred to, following the award of contract for Section "A" of the Church Street Line, when the appropriation was requested to cover the contract price, considerable opposition developed to the construction of outer tracks on Market Street. After extended deliberation the Supervisors finally appropriated the money so that the contractor could proceed with that portion of the work from Van Ness Avenue to Church and 16th Streets.

At the time the question of appropriation was being considered by the Board of Supervisors, Mr. Lillienthal, President of the United Railroads, made a proposal under the terms of which the City would be allowed to operate its Church Street cars over the Market Street tracks of the United Railroads to Van Ness Avenue on a mileage basis, and to route the Twin Peaks Tunnel cars down Market Street to the Ferry. This offer was rejected by the Board of Supervisors as far as its application to Section "A" of the Church Street road was concerned, but with the idea and the expressed intention of a number of the Board that when the question of appropriations for constructing the outer tracks connections on Market Street from Van Ness Avenue to Geary Street and from the Tunnel to Church Street already authorized by Ordinance of the Board of Supervisors should come up, further consideration would be given to the offer of the United Railroads. In the meanwhile, as time was running against the consummation of our transportation plans, it was essential that some decision be reached as to the policy to be adopted in order that the necessary material could be purchased. To develop a definite policy and bring the matter to a focus, this office took such steps as were within its province and certain negotiations were had with the United Railroads.

SAN FRANCISCO

MUNICIPAL REPORTS

FOR THE

FISCAL YEAR 1915-16, ENDED JUNE 30, 1916

PUBLISHED BY ORDER OF THE

BOARD OF SUPERVISORS

SAN FRANCISCO
NEAL PUBLISHING CO., 414 MISSION ST.
1918

1916—

January

Broadway between Octavia and Laguna.

Feb.

Webster Street between Broadway and Vallejo.
12th Ave. between Lake and Marine Lagoon.

March

Annie Lane between Eddy and Ellis.
Scott Street between Green and Union.

April

Washington Street between Jones and Leavenworth.

May

Jackson Street between Steiner and Fillmore.
Bryant Street between 5th and 6th.

June

Army Street, Sewer Terminal.
Ringold Street between 8th and 9th.

REPORT OF BUREAU OF ENGINEERING

FISCAL YEAR 1915-1916

San Francisco, July 1, 1916.

To the Honorable, the Board of Public Works,
of the City and County of San Francisco.

Gentlemen:—Herewith is transmitted the annual report of the Bureau of Engineering for the fiscal year 1915-1916.

In accordance with the policy of developing an adequate boulevard system with the greatest commercial and scenic possibilities, much work has been expended in improving main avenues for vehicle traffic

Railroad Avenue has been paved and graded so that when the new pavement shortly to be constructed on Third Street is completed, it will be possible to travel through the Industrial district on a smoothly paved boulevard 100 feet wide from Third and Market Streets to the County line.

Negotiations for the Hunter's Point road have been advanced and specifications prepared. This thoroughfare should be constructed during the coming year.

Twin Peaks boulevard has been practically completed. This Avenue ascends on an easy grade to an elevation of 830 feet and encircles the Twin Peaks near their summits. From it is afforded a view of the City and its picturesque surroundings unequaled on the Peninsula.

On the North Bay shore, one section of Camino del Mar, extending from Fort Miley to Lincoln Park along the cliffs above Bakers Beach into the Presidio Reservation, has been completed. For this construction the Panama Pacific Exposition contributed $56,000, and the City approximately $30,000, for rights of way. An extension of this boulevard into the Presidio has been assured by the Federal government. It can then serve both as a military road, affording ready access between Fort Miley and the Presidio, and also as a scenic drive from which an unexcelled close view of the harbor entrance is obtainable.

The first unit of the Esplanade along the Ocean Beach has been completed and the second unit is well under way. When this Esplanade is extended for the total length of the Great Highway from the Cliff House to Sloat Boulevard, San Francisco's Beach will excel in appearance any of the ocean fronts for which Southern California is famous.

To correct some of the mistakes in our rectangular street plan, several excessive grades have been reduced, notably on Hayes Street, Cumberland Street, Collingwood Street and at Larkin and Francisco Streets. All of these thoroughfares were formerly practically unusable by vehicles but since being regraded are readily accessible.

During the past fiscal year more pavements have been constructed in San Francisco under public assessment than in any other single period of the City's history, including:

Asphalt	381,523	sq.	yds.	at	cost of	$730,541
Bituminous Rock	21,520	"	"	"	"	46,191
Basalt Block	18,814	"	"	"	"	64,434
Vitrified Brick	18,828	"	"	"	"	63,083
Broken Rock	29,173	"	"	"	"	22,692
Cobblestone	2,395	"	"	"	"	5,039
Total	472,253	"	"	"	"	$931,980

In June, 1915, bids were invited for furnishing and delivering track and special work for the Church Street Railway, including the material for laying tracks on Market Street. Since that date this line has been completed from Thirtieth to Sixteenth and Church Streets. The City Engineer recommended that an agreement be reached with the United Railroads pending the settlement of the City's right to tracks on Market Street, whereby the Church Street line could be placed in operation immediately upon completion. This recommendation was not acted upon by the Board of Supervisors, with the result that the tracks on Church Street will be idle for an indefinite period.

Contract has been awarded for the extension of the Potrero Avenue line from Twenty-fifth Street to Army Street, the estimated cost of the extension being $10,000.

Bids were invited for furnishing steel rail for track through the Twin Peaks Tunnel, and contract has been awarded for the same.

Over 4300 feet of the Twin Peaks bore have been completed during the past fiscal year. The underground station at Laguna Honda is practically finished and only 4800 lineal feet remain to be completed. As the remaining portion contains no structural difficulties and is in a formation easy to excavate, it is expected that the entire tunnel will be completed before the end of the month of May, 1917.

A Strauss-Bascule bridge is being constructed across Channel Street waterway at Fourth Street, and the bridge over the channel at Third Street has been repaired, so that the newly developed industrial section to the east will be amply provided with avenues of approach.

Work on the main sewers during the past year was confined to the completion of Mile Rock Tunnel and Bakers Beach outlet; the construction of combined sewers in South Bay View District, Oakdale Avenue, San Bruno Avenue and Sloat Boulevard. In the Islais Creek District, a drainage channel was dug along the proposed route of a large reinforced concrete sewer, to reduce to a minimum the danger of floods from winter rains, from which some damage was done last winter.

Work on the Hetch Hetchy project has been materially advanced during 1915-1916. The 67-mile railroad extending from the junction of the Sierra Railway at Rosasco to Hetch Hetchy dam site, is being rushed and should be completed before next spring; a diversion tunnel, through which the Tuolumne River will be by-passed around the main dam site, has been finished; a large proportion of the timber needed for construction purposes has been prepared at the City's sawmill; roads have been built to all portions of the work; a power plant, at which will be generated the electricity for the various construction camps, is being built; the bottom of Hetch Hetchy reservoir has been cleared of timber so that it can be flooded during the coming winter, when the diversion dam, now under construction, will be completed.

Practically all of the application maps required in the Raker Bill have been filed. Application for power line location still remains to be made, but this will be done before December of the present year.

During the past fiscal year, the Department of Surveys established 2505 bench marks; made 1767 surveys for public and private contracts, street repairs, public buildings, etc.; made 40 surveys of lots for private owners; surveyed 6379 blocks and crossings, or a total of 692 miles. Fees collected and turned over to the City Treasurer by this department amounted to $20,623.25.

Instruments have been added to the Engineering Testing Laboratory so that it is now one of the most completely equipped laboratories on the Pacific Coast. In it were tested samples of all material used in City construction, including asphalt, brick, cement, concrete, steel, iron, paints, oils, and water, the total number of tests for the year being 8329.

Following is a detailed report of the various divisions included in Bureau of Engineering.

Respectfully submitted,

M. M. O'SHAUGHNESSY,
City Engineer.

BOULEVARDS.

The economic value of an adequate system of boulevards has not been recognized in San Francisco until recent years. No large city in the United States was so poorly provided with road approaches, and the condition of the main thoroughfare, within the City itself, was not a matter of civic pride.

In outlining a Boulevard System, numerous factors had to be considered. Adequate approaches from the southern end of the Peninsula had to be provided, direct lines of communication between the principal districts of the City established, and suitable routes, from which the desirable features of the City could be viewed, had to be chosen.

Pursuant to the policy of developing to the utmost the City's commercial and scenic possibilities, the Boulevard System has recently been extended.

To provide for the manufacturing district, Railroad Avenue has been paved with asphalt and all excessive grades eliminated. This thoroughfare connects with San Mateo on the south by means of the San Bruno Road, on which paving is now almost completed as far as the County Line. On the north, Railroad Avenue joins with and practically merges into Third Street near the intersection of the latter thoroughfare with Islais Creek. Third Street will soon have a smooth pavement from this junction to its northerly terminus, so that it will be possible to travel through the industrial region on a smoothly paved boulevard 100 ft. wide from Third and Market Streets to the County Line. This route will materially shorten the distance to San Mateo.

Extending easterly from Railroad Avenue along Evans Avenue, a new roadway has been planned to reach Hunters Point drydock. The route will be along Evans Avenue as far east as Ingalls Street; thence on an easy curve to the intersection of Fairfax Avenue and Hawes Street; thence along the last named thoroughfare to Innes Avenue, which will form a portion of the roadway for a distance of four blocks to Donahue Street; thence along Donahue Street to Galvez Avenue, to Coleman Street; thence diagonally to Alvord Street, the entrance to the California Dry Dock Company's property.

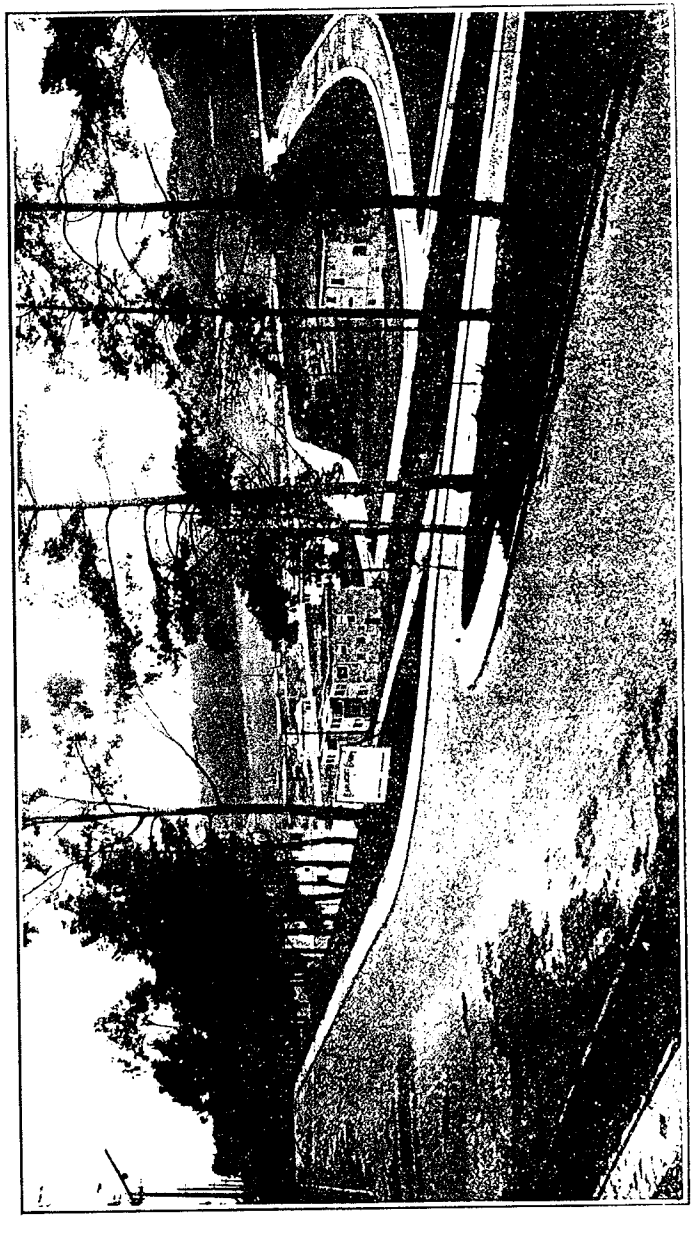
Specifications for the pavement of this roadway have been prepared and arrangements made by which the entire thoroughfare will shortly be constructed, the City paying a portion of the cost, and the remainder to be assessed to the owners of adjacent property.

For many years the industrial district, which will be served by this road, has been absolutely neglected, and many manufacturing enterprises have been forced to seek accommodations in transbay cities or further south along the Peninsula, because there were no adequate roadway approaches to the industrial sites along the east shore of the Bay, which is naturally a manufacturing district. Already the Union Iron Works is building a dock which will be 1,000 ft. long, 120 ft. wide, and cost over $2,000.000, and reached by this roadway.

The Twin Peaks Boulevard now rapidly nearing completion, starts at the intersection of St. Germain and Burnett Avenues, ascends to and encircles near their summits, the two hills known as Twin Peaks at an elevation of 830 ft.; and thence descends to terminate in Corbett Avenue at a point about 900 ft. distant from the westerly boundary line of the San Miguel Rancho.

The roadway consists of an asphalt pavement 25 ft. wide with a 7 ft. 6 in. rock shoulder adjoining it on each side, giving a total width of 40 ft. The pavement is composed of a concrete base 6 in. in thickness, covered by a binder course 1½ in. thick and a 1 in. asphaltic wearing surface. Before constructing any pavement, the subgrade was thoroughly compacted by rolling with a 12-ton road roller.

Surface drainage is carried off by 12 in. corrugated steel culverts, encased in concrete, underlying the roadway at required points. Water collecting in side ditches is discharged into concrete inlets and thence through the culverts.



Portola Drive near West Portal of Twin Peaks Tunnel.

A guard rail consisting of two 2 in. by 6 in. surfaced pine rails nailed to 6 in. by 6 in. surfaced redwood posts 8 ft. apart was constructed in the shoulder adjoining the fill side of the roadway.

The contract for the construction of that section of the boulevard extending from St. Germain Avenue through the City Reservoir site was awarded on June 25, 1915, to Eaton & Smith for the estimated sum of $24,058.

This portion of the boulevard is approximately 2,800 ft. long and its construction necessitated the excavation by steam shovel of approximately 30,000 cubic yards of rock and earth, the construction of 70,000 square feet of pavement and 2,730 lineal feet of guard rail.

The maximum grade on this section of the boulevard is 9% and the sharpest curve has a radius of 60 ft. The roadway on curves is super-elevated to insure safe and easy riding, the maximum super-elevation on the curve mentioned being 14 in.

One of the most notable features of this unit of the boulevard is a curve forming a full semi-circle or horseshoe with a center line radius of 68 ft. To eliminate accidents on this curve, 3,000 cubic yards of rock were excavated in the interior core within the horseshoe to give a clear and unobstructed view across the same.

Work under this contract was completed April 1, 1916, and the roadway thrown open to traffic immediately.

The contract for the second section of the Twin Peaks Boulevard extending from the City Reservoir site to Corbett Avenue was awarded on September 20, 1915, to F. R. Ritchie & Co. for the estimated sum of $54,745.

This unit of the boulevard is about 7,900 ft. long, 6,820 ft. of same being built on an acquired right of way. The contract included the excavation of approximately 63,000 cubic yards of rock and earth and the construction of 202,121 square feet of pavement, 960 lineal feet of 12 in. culvert and 8,000 lineal feet of guard rail.

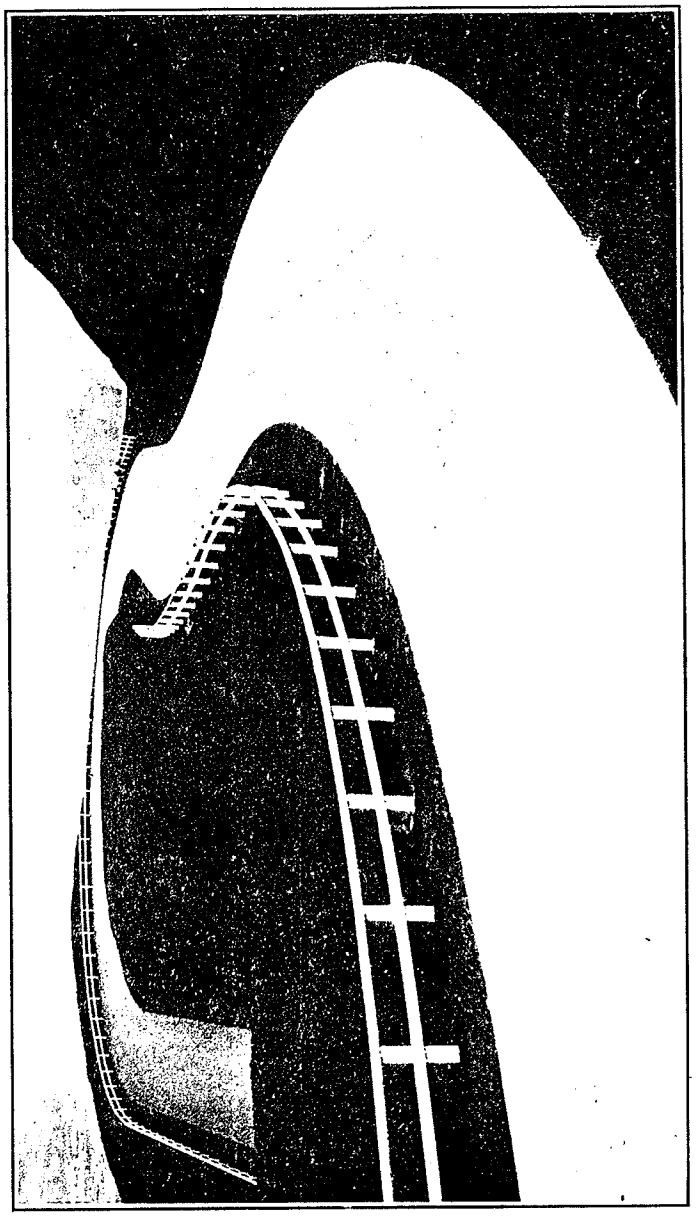
Excavation was performed by a steam shovel. For fills the excavated material was placed in the piles by means of scrapers and dump wagons and thence rolled in layers by a 12-ton road roller. One of the fills underlying the roadway is 60 ft. deep. The surface of the side hills underlying the fills was thoroughly plowed before placing any material for fill.

The maximum grade on this section is 9 per cent and the sharpest curve has a radius on the center line of 60 feet. The roadway has a uniform crown of 2½ in. and it is super-elevated on all curves.

The boulevard encircles the two peaks at approximately the 825 ft. contour, giving a closed loop resembling the figure 8, the distance around same being 3,173 lineal feet.

A magnificent view of the City of San Francisco and surroundings may be obtained from any point on this loop. Work under this contract is now practically completed.

Another boulevard recently constructed is the Camino del Mar, extending from Fort Miley to Lincoln Park, along the cliffs above Bakers Beach into the Presidio Reservation near Lobos Creek, a length of 1,665 ft. This boulevard will serve as a military road, for which reason $30,000 was donated by the Federal government for extending the same through the Presidio Reservation to connect with the McDowell Drive. Eventually the road will be extended to connect with the Marina on the north shore of the Bay, and from Fort Miley southerly to join the Ocean Beach Esplanade, the construction of which is described in detail later in this report. The Panama Pacific Exposition contributed $56,000 for paving and the City $30,000 for acquiring rights of way in this project.



Portion of Twin Peaks Boulevard.

From Camino del Mar, an excellent view of the inner bay and Marin hills is obtainable, and the picturesque scenery along the route is impressive alike to resident and tourist.

A portion of the boulevard system is now in course of construction along the Ocean Beach. Eventually the Esplanade will be extended as far south as the Sloat Boulevard and an additional road will lead from its terminus around Lake Merced. At the present, one section of the Esplanade protection wall is being constructed and the contract for the second section has been awarded.

A scenic road around Telegraph Hill has been planned by the Bureau of Engineering and a small appropriation was requested of the Board of Supervisors which would enable the purchase of some of the lands necessary for its construction. Work on the Telegraph Hill Boulevard should be started during the fiscal year 1916-1917, which would permanently prevent the hill from the inroads of quarrymen.

Work will soon be started on the paving of Clarendon Avenue from Clayton Street southerly to connect these two completed sections around Twin Peaks with the already constructed boulevards leading southerly from Haight Street around Buena Vista Park.

Construction work has been completed on Plan No. 1 of the Market Street Extension, Corbett Avenue between 24th Street and the San Miguel Rancho. This consists of a 20 ft. roadway with two 7½ ft. shoulders, similar in construction to the Twin Peaks Boulevard described above.

The following tabulation shows the progress made on the principal units of the Boulevard System during the last fiscal year:—

	June 30, 1915	June 30, 1916
1 Junipero Serra Blvds.	Completed	
2 Sloat Boulevard	"	
3 Portola Drive	75% completed	Completed
4 Market Street Extension (Corbett Ave. Plan No. 1)	Proposed	
5 Market St. Extension (Plan No. 2)	"	Preliminary studies being made
6 19th Ave. Boulevard	Partly completed	Completed
7 Ocean Boulevard	" "	Finished save portion in Presidio, funds for which Congress recently appropriated
8 San Bruno Extension	" "	Completed
9 The Great Highway and Esplanade	Proposed improvement	Sect. "A" 500 ft. long 65% completed
10 Twin Peaks Blvd.	1st unit awarded	Both units completed
11 Hunters Point Blvd.		Proposed
12 Telegraph Hill Blvd.		"
13 Marina Boulevard		"
14 Twin Peaks Extension		"
15 Clarendon Ave., Clayton to St. Germain		Contract awarded

View of Richmond and Sunset Districts from Twin Peaks Boulevard.

BERNAL CUT.

As outlined a year ago, this improvement is badly needed but its acquisition will have to be deferred until provision has been made to finance the purchase of right of way and cost of construction work.

OCEAN BEACH ESPLANADE.

The first section of Ocean Beach Esplanade now under construction on the west shore of the City just south of the Cliff House by J. D. Hannah, Contractor, was started January 10, 1916. The structure is planned primarily for beach protection, having a front wall formed by driving interlocking concrete piling to depth of 13 ft. below extreme low tide. These piles were precast, are 10 in. thick, 4 ft. wide and 20 ft. long and when in position form a reinforced concrete curtain wall 10 in. thick extending north and south. 28 ft. to the east of this outer line of sheet piles are located pedestal piles 18 in. square with 3 ft. square bulb and 24½ ft. in length and spaced at 10 ft. centers. Between these two rows of piles are placed heavy reinforced beams 20 in. by 43 in. by 27½ ft. weighing 13 tons, which form the main ties, and by means of keyways support the intermediate slabs of concrete. These beams are placed on 20 ft. centers except at stair sections where they are at 10 ft. centers. The space between beams is concreted to form a heavy reinforcing slab, 5 bleacher seats and 3 stringers for additional support. The stringers have a cross section 16 in. by 18 in. The entire section between the beams has a solid bearing on sand and 18 in. of packed clay. The minimum thickness of this bleacher section is 12 in. The last bleacher riser develops into a rollway and this rollway ends at top of and forms part of a 3½ ft. parapet wall with returns at either side of each stairway section. Behind the parapet is a 20 ft. sidewalk with scrupper holes to release wave water, and 6 in. concrete curb and gutter.

Over the front row of sheet piles is a heavy reinforced concrete slab 4 ft. thick and 6 ft. wide which caps the piles and forms a main support for lower ends of beams and intermediate slabs. At the upper end of beams, bearing on pedestal piles is a similar cap which ties the upper portion of slab and structure together. Expansion joints are provided and likewise drinking fountains and electric light connections.

All sheet piles, H beams and pedestal piles were precast, allowed to season for 40 days and then put into position. Most of the precast work was done on the bank above the beach and hauled to position on cars over a construction track. Some were cast on the beach and handled directly by derrick. All piles were driven by 4 water jets and steam hammers.

Two jets of 2 in. pipe reduced to ¾ in. at discharge end were used on each side of sheet piles and one at each corner of bulb on pedestal piles and in both cases were so located that they discharged about 1½ ft. below the bottom of pile.

Water for jetting was supplied by the Olympic Salt Water Co. under static pressure of 130 pounds and nozzle pressure of 40 pounds per jet. Consumption of water by jetting process was approximately 100 cubic feet per minute. The steam hammer was made useful by the fact that the summer beach level is 8 ft. above required grade on sheet piles, and if placed to required grade by jets, it would be impossible to interlock the next pile. Therefore, 10 or 11 sheet piles were placed to sand grade and then with hammer and jets were driven to the required grade, one sheet pile always remaining at sand level to start next pile. Pedestal piles were jetted to required grade without the use of hammer. All jetting was accomplished without very great difficulty. Floating boulders, especially at the north end of the contract, gave some trouble, making it necessary to excavate 8 feet to winter beach level and then remove boulders.

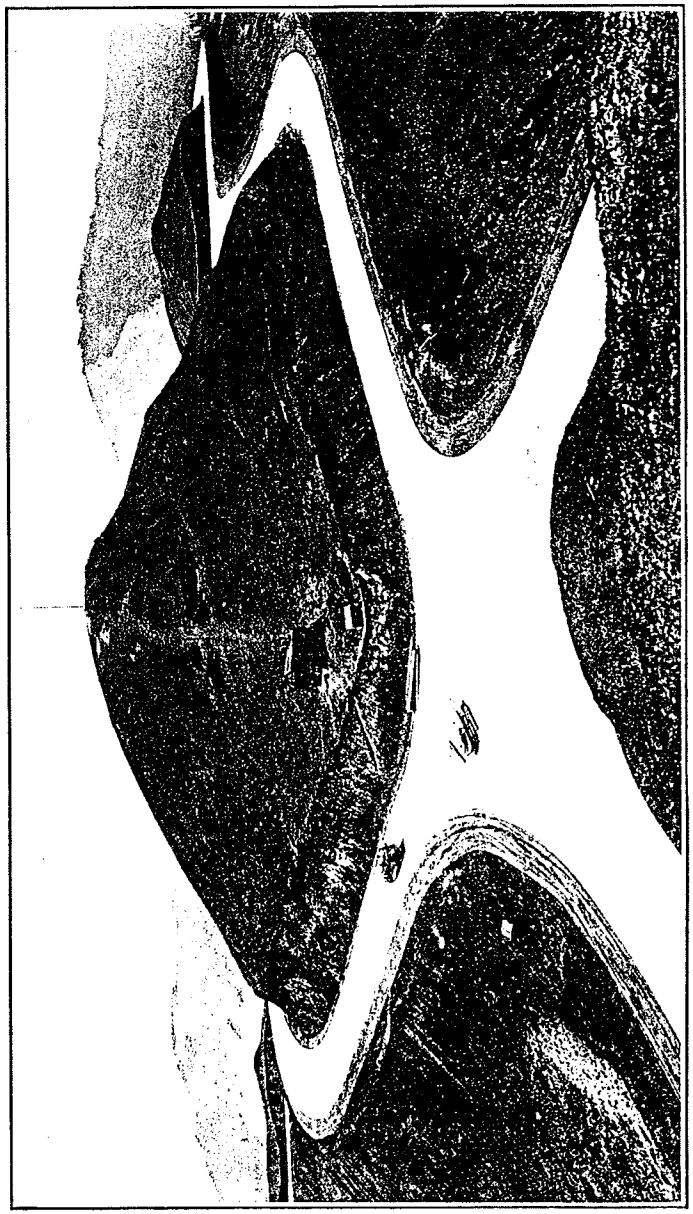


Figure 8 on Twin Peaks Boulevard.

On all precast work the concrete mix was 1-1½-3. The concrete on balance of work will be 1-2-4, the same being used throughout.

At present the driving of all piling is complete, H beams are in place and graded, and sheet piles poured. Bleacher section forms are in place and tamping of sand and clay under bleacher slab is in progress. Over 250 lineal feet of bleachers have been poured. Contract will be completed with the possible exception of sidewalk and backfill by August 1.

Contract for the second unit of the esplanade was awarded in July, 1916, to J. D. Hannah for $23,148.90. This provides for an addition of 170 lineal feet of structure identical with that described above, so that by November 1, 1916, 670 ft. of structure will be completed. It is to be hoped that in the forthcoming budget enough money will be appropriated to complete this deserving project as far south as the chalet pile structure built some years ago.

REGRADES.

On account of the excellent landscape views obtainable from their slopes, some of San Francisco's hills are extremely desirable as residence sites. Unfortunately, however, little thought was given to topography by the surveyor who first laid out the City in 1848. One set of streets was run parallel to the meridian, and another at right angles thereto. The fact that this gridiron plan would later necessitate grades as steep as 55 per cent on some streets and thereby greatly detract from the value of adjoining property, apparently was overlooked until many years later.

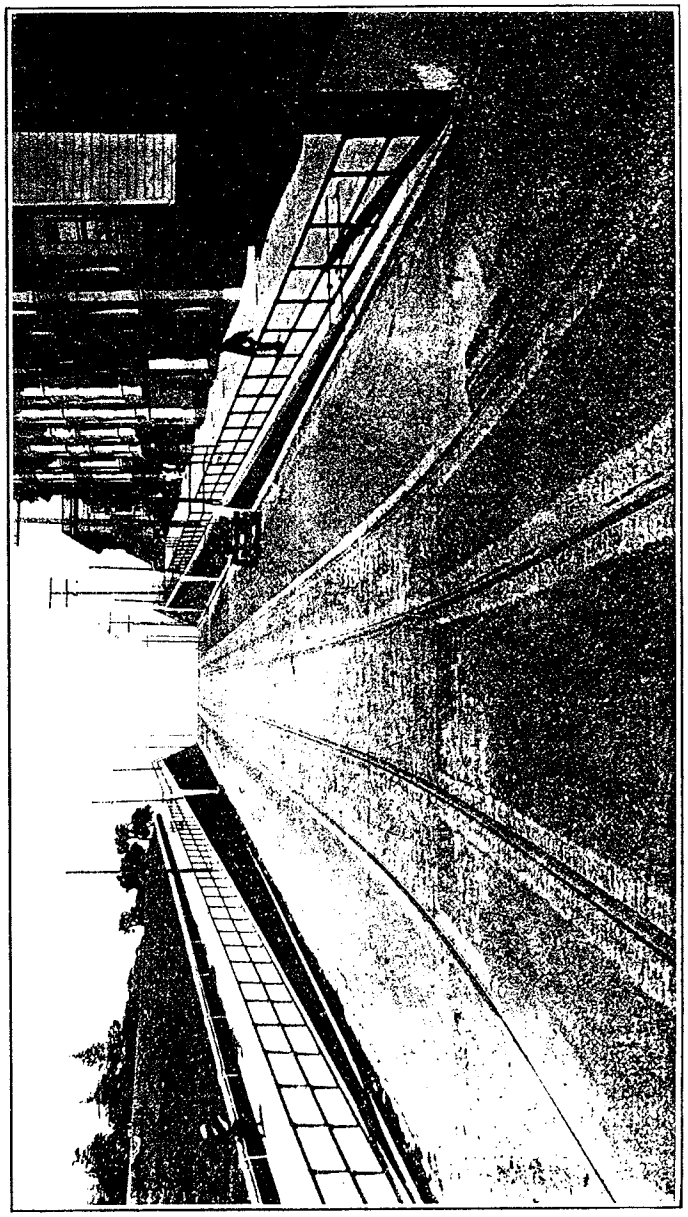
To eliminate, at a minimum cost, as many as possible of these excessive grades has been the policy of the City Engineer's office. No standard plan has been adopted to suit every grade, but a separate study is made of each case, and the improvement best adapted thereto recommended.

At the request of the property owners affected, the grade of Larkin Street between Chestnut and Francisco Streets has recently been reduced from 29 per cent to a maximum of 16 per cent. The cost of this improvement is being paid by the owners having frontage on the streets to be regraded. On Larkin Street $16.31 per front foot will be assessed against the property on each side of the street, and on Francisco Street the rate will be $20.29 per front foot. Present property values on both these streets are now in the neighborhood of $115 per front foot. The regrade will advance this value to over $250.

For a width of 28 ft. the east side of Larkin Street between Chestnut and Francisco Streets has been cut down to descend on a uniform 16.07 per cent grade. On this incline is an 18 ft. vitrified brick roadway and a 10 ft. artificial stone sidewalk. This strip is separated from the west side of the street by a reinforced concrete retaining wall, and near the bottom of the hill turns westward into the southerly side of Francisco Street. The west side of Larkin Street has been graded to a higher elevation than the east side, and descends on grades varying from 4.37 to 10.92 per cent, for a distance of 157.5 ft., where its vitrified brick roadway 28.25 ft. wide terminates in a parked slope. At its termination the west roadway is 12 ft. higher than the east roadway directly opposite. The sidewalk continues down the west side in a series of steps to the level of the easterly strip at Francisco Street.

Turning westerly, the steeper strip continues to descend on a 16 per cent grade along the south side of Francisco Street for a distance of 127.5 ft., separated from the north side of the street by a reinforced concrete retaining wall. Around the westerly end of this wall the roadway turns through 180 degrees, descending easterly along the north side of Francisco Street on a 3.6 per cent grade, back to Larkin Street, into which it turns northerly.

By this detour a roadway suitable for automobile traffic has been provided from the North Beach District to the higher levels on the south, and some very



Hayes Street Regrade.

desirable hillside home sites, now inaccessible and undeveloped, opened for immediate settlement.

Contract for this construction was awarded to F. Rolandi at an estimated cost of approximately $30,000. The construction will be completed in the immediate future.

The entire expense of this work is being paid for voluntarily by the property owners, without any appeal to the municipal treasury. They co-operated with this office in the most friendly manner to adjust the problems connected with this work.

HAYES STREET REGRADE.

This improvement has recently been completed and consisted of cutting the roadway down between curb lines for a maximum of 15 ft., thereby establishing a 10.909% grade between Scott and Pierce Streets in lieu of the 14.54% grade previously existing, and lowering the intersection of Pierce and Hayes Streets an average of 14 ft. Retaining walls at the curb lines form the sides of the cut, stairways being provided at intervals connecting the street with the sidewalks on the upper level. Sewers and public service pipes were placed under the sidewalks. The Hayes Street electric car line which formerly detoured at Fillmore Street to reach the district west of this regrade now continues directly over Hayes Street through the new cut, effecting considerable saving in time and power. On this work 11,500 cubic yards of excavation was done by the Street Railway Company while the City paid $16,000 for the balance of the improvement.

Bids are about to be received for the improvement of Cumberland Street, Sanchez to Noe Streets, and Sanchez Street, 19th to 20th Streets, and proceedings have been started for the improvement of Leavenworth Street, Chestnut to Hyde Street.

Collingwood Street, 20th to 22nd Streets, and 21st Street and 22nd Street between Castro and Diamond Streets, are to be treated shortly to improvements that will tend to make accessible this very precipitous district.

Other projects of a similar nature are:—

Bartol Street, Vallejo and Broadway, Kearny and Montgomery Streets;
Caselli Avenue, Falcon and Eagle;
Caselli Avenue, Clayton, Corbett, Mars.

MUNICIPAL RAILWAYS.

CHURCH STREET ROAD

Article XII of the new Charter of the City and County of San Francisco which became effective January 8, 1900, declares it to be the intention of the people that its public utilities shall be gradually acquired and ultimately owned by the City and County of San Francisco.

With particular regard to the ownership and operation of its street railway system, this policy may be considered to have been ratified by the people when on December 30, 1909, at a special election they voted $2,020,000 of bonds for the construction of the Geary Street Railway, the franchise for the old Geary Street Cable Road having expired in 1903. With this money the Geary Street Municipal Railway was constructed and operation from Kearny Street to the Beach and Park commenced on December 28, 1912; on June 24, 1913, operation was extended to the Ferries.

The Panama-Pacific Exposition a little later made imperative the immediate expansion of the Municipal Railway System to provide transportation to and from the fair grounds. The site selected for the Exposition, while ideal in some

respects, was somewhat inaccessible and presented a serious problem in the matter of street transportation. The only lines running anywhere near the Exposition were the Fillmore Hill and the Polk Street Lines of the United Railroads and the Union Street Line. The exposition directors, City officials and Railway officials were impressed with the need for action and gave the matter early and serious consideration. In addressing the Board of Supervisors on the subject on February 5, 1913, C. C. Moore, President of the Exposition Company, said: "I do not think we are saying too much when we say that the burden of supplying adequate street railway transportation to the Exposition belongs to the City and not to us. We want to tell you how desperate this is, how utterly and completely inadequate the present facilities are. * * * With no street car facilities to the Exposition Grounds our $100,000,000 structure, built by our pride and our patriotism, so far from fruition, will be a sad thing to contemplate."

At the same meeting, Mr. Mullaly, Exposition Director, and Vice President of the United Railroads, stated most emphatically that "The United Railroads will not build one foot of additional street railroad under present charter conditions."

Confronted with these conditions, upon the request of the Directors of the Panama-Pacific International Exposition, the Board of Supervisors by resolution directed the Board of Public Works to have the City Engineer submit plans and estimates of cost of a Municipal Railway System designed to furnish to the Panama-Pacific Exposition an adequate street railway service and at the same time form a nucleus for a desirable Municipal Railway System.

In accordance with this resolution the City Engineer on April 5, 1913, submitted to the Board of Public Works for transmittal to the Supervisors, a report upon the extensions of Municipal Railways to provide transportation for the Panama-Pacific International Exposition. Acting upon this report, the question of a bond issue of $3,500,000 for constructing the lines recommended therein was submitted to the people and overwhelmingly carried at an election held August 26, 1913.

The subsequent program of prompt and efficient construction under the supervision of this department—all work being completed on time—provides a unique exhibit of municipal efficiency.

The Exposition has since passed into history, but it is of interest to review a few of the figures bearing upon the attendance and the transportation that it may better be appreciaed how necessary these lines were to the success of the Exposition and how well the demands were met.

The total attendance at the Exposition for the 288 days was 18,875,974. It is estimated that at least 50 per cent of this number was handled on the Municipal lines, representing approximately $1,000,000 in fares due to the Exposition traffic alone.

The greatest attendance for any single day was on closing day, December 4, when 458,558 people attended the Exposition. The Municipal Railway receipts on this day were $16,748.20, representing 334,964 cash fares; or in other words, 36½ per cent of the total attendance rode both ways on the Municipal lines.

The second largest day was San Francisco Day, the attendance being 348,372, the railway receipts $13,922.75, or 40 per cent of the attendance both ways.

The third largest day was opening day, 255,149, when the railway receipts were $13,299.70, or 52 per cent of the attendance. All of these days were holidays and practically all of the business handled by the roads was Exposition traffic. The reduction of the percentages as the attendance of 255,000 was exceeded, indicates that the capacity of the lines was practically reached on these three days that the crowds were not comfortably handled. The pre-Exposition estimate was that there would be at least one day in excess of 250,000 attendance.

The total Municipal Railway receipts for the Exposition year were $2,255,841.15 to apply to interest, depreciation and reserves. It is interesting to note

that this surplus represents practically the total cost of the track construction for the Exposition extensions.

Of all the lines provided for under the 1913 Bond Issue the Church Street line was the only one not completed for service prior to the opening of the Exposition.

An examination of the Journal of the Board of Supervisors will reveal the extent and bitterness of the controversy aroused at the time that the construction of this road was up for consideration. Briefly, the history of this Church Street controversy which was the cause for the delay in the construction of this line, is as follows:—

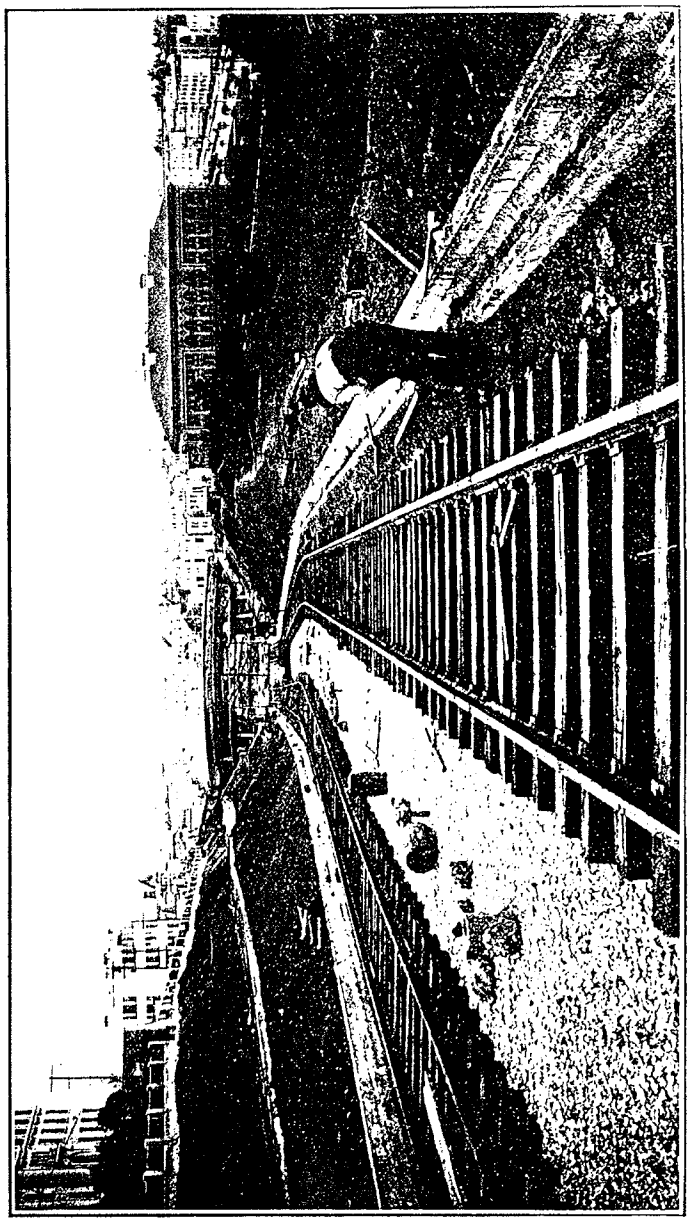
The City Engineer recommended that the Church Street line be diverted from Church Street through Mission Park and a private right of way acquired from 18th to 22nd Sts., for the purpose of making a detour to overcome the extreme grade of 19.3 per cent on a direct route over Church Street between 20th and 21st Streets. In connection with this diversion it was planned also to open a street along the railroad grade for the accommodation of vehicular and pedestrian traffic, the cost of opening this street to be paid for by an assessment on the property benefited. The assessment feature aroused a storm of protest from a number of the affected property owners.

In an endeavor to effect a solution of this Church Street problem satisfactory to all interests, some nine comprehensive studies were made by the City Engineer, including, by an order of the Board of Supervisors, the preparation of complete plans and specifications for a cable operated road over the hill. After protracted discussion by the Board of all the possible solutions, which lasted for eighteen months, on February 8, 1915, the Supervisors passed an ordinance empowering the Board of Public Works to authorize the City Engineer to prepare plans, specifications and contracts and advertise for bids for furnishing necessary material for constructing the Church Street extension of the Municipal Railway System and approving the plan for overcoming the grades between 18th and 22nd Streets by a diversion through Mission Park and private property between 20th and 22nd Streets. This plan, as finally approved, follows closely the original recommendation of the City Engineer as to location, but the right of way was narrowed to 28 ft. and is without provision for pedestrian or vehicular traffic. Under pressure of the protestants organized as the Church Street Non-Assessment League, the Supervisors agreed that the City would assume the expense of opening the railroad right of way, thereby adding something over $150,000 to the charges against the railroad construction.

By comparing the finally adopted plan with the tunnel project suggested in Arnold's report, Page 278, which would have cost $100,000 more to execute and be less desirable for use, the City is to be congratulated on the final outcome and much well deserved credit should be given to Messrs. Ransom and Eckart of this office for their intelligent zeal in furthering this work.

Acting upon the ordinance authorizing the construction in June, 1915, bids were invited for furnishing and delivering the track special work for the Church Street Line, including the track special work for laying outer tracks on Market Street. The question of purchasing this material for the outer tracks on Market Street was put up to the Supervisors, but no decision was reached until December 1, 1915, when the Board of Public Works was authorized to purchase all of the materials for the Church Street Line except those for the outer tracks on Market Street from Van Ness Avenue to Church Street.

Contracts were awarded for constructing one section of the Church Street Line from 18th to 22nd Streets, and another section from 16th to 18th Streets and from 22nd to 30th Streets. Both of these contracts have been completed prior to July, 1916, but owing to a controversy with the United Railroads and an injunction, the City has been unable to connect its Church Street tracks with the other tracks of its system. The City Engineer's office had previously taken



Grade for Detour on Church Street Railroad.

this matter up and agreed with the engineers of the United Railroads on the valuation of the tracks between Market Street and 16th Street on Church Street, which tracks formed a part of the Church Street Line under the original plan. Arrangements also were made with the United Railroads by which connection would be made with the United Railroads tracks on 16th Street at Potrero Avenue and at Church Street for the purpose of permitting temporary routing to and from the Potrero Avenue car barn from the Church Street tracks, the City paying the United Railroads a nominal charge for current and wear and tear on the track and overhead. Pending the settlement of the question of the City's right to lay tracks on Market Street, the United Railroads agreed to an exchange of transfers at Church and Market Streets. These arrangements, which offered a temporary solution for the operation of the Church Street Road, were never consummated owing to the refusal of the Board of Supervisors to allow the exchange of transfers at Church and Market Streets on a 40-60 basis, that is, redeeming Municipal transfers for three cents from the United Railroads and allowing the United Railroads to redeem their transfers to Church Street on a two cent basis. This interchange was recommended by the City Engineer's office as being equitable based on the ratio of the lengths of the lines involved, the Church Street line being approximately 9,000 ft. against 14,000 ft. operated by the United Railroads on Market Street.

In order to precipitate matters and bring the questions into court for a final settlement of all the questions involved, the City commenced the installation of the outer tracks on Market Street at Van Ness Avenue on June 12, 1916, but were stopped from proceeding by an injunction secured in a Federal Court. This matter is still in the courts at the present time and it will probably be several years before it is finally settled as both the City and the United Railroads are determined to carry the matter to the highest tribunal.

In the meantime, a second contract for purchasing track special work for the Market Street section of the Church Street Line has been awarded to the United States Steel Products Company, which provides that the City may order this material at any time within a period of one year or abandon the contract, so that whenever this matter is settled favorable to the City, work can proceed immediately on the construction of the track.

Owing to the complex proposal connected with the Church Street work, it is interesting to recite the different public proceedings incident to the successful completion of a portion of this work:—

CHURCH STREET LINE—MUNICIPAL RAILWAYS

Connection between Van Ness Avenue and Church Street.

June 29, 1914—Resolution directing Board of Public Works to prepare plans and specifications for the construction of the Church Street Line from Market Street and Van Ness Avenue to Dorland and Church Streets to 30th and Church Streets, and that the construction of this unit be proceeded with as soon as possible, owing to difficulty in getting satisfactory plans for portion between 22nd and Dorland Streets.

Motion introduced; laid over 3 weeks.

Aug. 3, 1914—Above motion reported on adversely by Public Utilities Committee and refused passage, 10 to 6.

Dec. 21, 1914—Ordinance authorizing Board of Public Works to prepare plans and specifications and contracts, and advertise for bids for material for constructing the Municipal Railway along Market to Church Street and along Church Street to the northerly line of 18th Street. Introduced by Vogelsang; referred to Public Utilities Committee.

Jan. 4, 1915—On motion of Supervisor McCarthy, consideration of ordinance laid over 2 weeks; 13 to 4.

Jan. 19, 1915—Ordinance authorizing construction of Church Street Line from Van Ness Avenue out Market Street to 18th and Church Streets; brought up and made special order of business for the following Thursday at 3 P. M.

Jan. 21, 1915—J. R. 1626, introduced by Power, requesting City Engineer to present estimate of cost of Church Street road, utilizing United Railroads trackage now in place on Market and Church Streets; carried unanimously.

Ordinance authorizing Board of Public Works to prepare plans and specifications for the construction of the Church Street extension from Van Ness Avenue and Market Street to 18th and Church Streets, indefinitely postponed on motion of Supervisor Vogelsang.

Jan. 25, 1915—Motion introduced by Supervisor Power requesting United Railroads to advise Board of Public Works to enter into agreement with City for use of Market Street tracks; lost 8 to 8.

Feb. 1, 1915—Report of City Engineer dated January 27, 1915, showing estimate of cost of constructing Church Street Line, recommending that authority be given the Board of Public Works to immediately advertise for bids for furnishing material and labor necessary to construct the Church Street extension from Van Ness Avenue and Market Street to 30th and Church Street, and recommending that the Board of Supervisors pass a resolution indicating whether they desire that additional tracks be constructed outside of the United Railroads tracks on Market Street from Van Ness Avenue to Church Street or to use the United Railroads tracks on this street.

Thereupon Supervisor Vogelsang presented a bill directing the Board of Public Works to prepare plans and specifications for the construction of the Church Street extension. Passed to print.

Feb. 8, 1915—Ordinance authorizing Board of Public Works to advertise for bids for constructing the Church Street road from Van Ness Avenue and Market Street to 30th and Church Streets; adopted 11 to 6.

J. R. 1662 introduced by Vogelsang, authorizing Mayor and City Attorney to enter into negotiations with the United Railroads for the joint use of tracks on Market Street. Carried unanimously.

June 19, 1915—Board of Public Works invited bids for furnishing and delivering track special work for the Church Street line, including track special work for outer tracks on Market Street from Van Ness Avenue to Church Street.

June 26, 1915—Board of Public Works called for bids for furnishing and delivering steel rails, rail fastenings and joints for the Church Street Line.

July 9, 1915—Letter from City Engineer to the Board of Public Works recommending that the question be submitted to the Supervisors and a decision obtained from them as to whether or not it is their intention to have outside tracks constructed on Market Street.

July 22, 1915—Recommendation of City Engineer to award contract for track special work and advising contractor not to execute work until policy settled.

July 27, 1915—Letter from City Engineer to Board of Public Works awarding contracts for various materials and recommending contract be held up pending settlement by the Supervisors as to the question of constructing outer tracks on Market Street.

Sept. 20, 1915—Communications from the City Attorney and Mayor relative to negotiations with the United Railroads for the use of the Market Street tracks, indicating that no agreement was probable.

Dec. 1, 1915—Approximately, Public Utilities Committee, Board of Supervisors, authorized purchase of all materials not actually involved in constructing outer tracks on Market Street.

Dec. 7, 1915—Report of City Engineer to Public Utilities Committee suggesting three possible solutions for operation on Church Street Road.

Jan. 3, 1916—Bill No. 3907 authorizing submission of an offer to United Railroads for purchase of west of Twin Peaks Tunnel Line with provision for interchange of transfer at Church and Market, etc. Recommitted to Public Utilities Committee.

Apr. 3, 1916—Resolution No. 12,772 (new series) accepting offer of United Railroads for use of tracks on 16th Street from Potrero Avenue to Church Street. Accepted. Passed 17 votes.

May 1, 1916—Resolution No. 12,887 directing Board of Public Works to proceed with construction of outer tracks from 16th and Church Streets to Van Ness Avenue and Market Street. Adopted. 17 votes.

May 2, 1916—United Railroads refuse to allow installation of track crossing at 18th and Church Streets.

May 4, 1916—Conference Mayor Rolph, Judge Sullivan, M. M. O'Shaughnessy, N. A. Eckart; decision made to install 18th Street crossing on Saturday afternoon and Sunday.

Apr. 29, 1916—Section "C" of Church Street Line completed.

May 13, 1916—Commenced installation of crossing at 18th and Church Street at 1 P. M.; in place ready for operation of United Railroad cars Sunday morning.

May 14, 1916—Connected up rails of Section "C" with crossing.

May 18, 1916—Letter withheld from Board of Public Works.

May 19, 1916—N. A. Eckart in consultation with Mayor Rolph relative to installation of crossing at Van Ness Avenue and Market Street.

June 9, 1916—Conference, Mayor Rolph, Judge Sullivan, George Lull, M. M. O'Shaughnessy, N. A. Eckart, relative to installation of tracks on Market Street and laying foundation for suit.

Decided to install crossing at Van Ness Avenue and Market Street on June 12.

June 12, 1916—Resolution of Board of Public Works authorizing City Engineer to construct outer track on Market and Church Streets by day labor.

1 P. M. commenced opening street to install crossing.

June 13, 1916—Enjoined from further work.

June 28, 1916—Section "B" track work completed.

July 21, 1916—Contract No. 81 for installation of trolley wires completed and road ready for operation except connection with United Railroads.

Aug. 22, 1916—Judge Hunt (U. S. Circuit Court) commenced hearing of case.

Aug. 25, 1916—Completed hearing of case. Fixed October 10 as date for submission of final briefs of United Railroads in rebuttal.

In the last annual report mention was made of the proposed extension of the Municipal Railway across Golden Gate Park from 10th Avenue and Fulton Street to 14th Avenue and Judah Street, the plans and specifications for which road at that time were approximately 90 per cent completed. Upon the completion of these plans, they were submitted to the Board of Park Commissioners in November, 1916, with the request that the Park Commissioners give their consent to the construction of this line in accordance with the plans prepared. This request was met with absolute refusal and with the counter-suggestion that if the Park was to be crossed it should be in the vicinity of 20th Avenue and then in a subway or tunnel. The cost of such a tunnel being in the neighborhood of $800,000 was of course absolutely prohibitive and warranted no consideration. Following upon this action by the Park Commissioners, the Board of Supervisors passed a resolution directing the Board of Public Works to immediately proceed with the construction of the line across the Park in accordance with the plans prepared under the original ordinance. This resolution was vetoed by His Honor, Mayor Rolph, and later failed of securing the necessary votes to pass over the Mayor's veto. Immediately prior to vetoing the resolution, the Mayor called a conference of the Park Commission and representatives of the Supervisors and the City Engineer in an endeavor to reach some solution. At this conference the Park Commission remained firm in their stand to oppose the construction of the Golden Gate Park Line between 10th Avenue and Fulton Street and 14th Avenue and Judah Street, but offered as a compromise to permit a surface crossing at 20th Avenue, the crossing to follow the City Engineer's plans as developed for the original location. Due to the excessive outlay involved for this 20th Avenue route, the loss of earnings from the missing patronage of the music stand region the desirability of its construction now may be well questioned if the funds are available. The construction of the line across Golden Gate Park is at present in a somewhat anomalous condition. There is an ordinance authorizing and directing the Board of Public Works to construct this line between 10th Avenue and Fulton Street and 14th Avenue and Judah Street and the City Attorney has held that the Supervisors have the authority to order the construction of this line across the Park regardless of the opposition of the Park Commission provided that such road does not interfere with the free use of the Park for park purposes. Eminent attorneys, on the other hand, question this and nothing but a Court decision can absolutely determine the question. In view of this it is doubtful if any line will be built across the Park for some time to come.

In conjunction with the extension of Potrero Avenue south this office has recommended, and the Board of Supervisors have authorized, the construction of an extension to the Potrero Avenue Line from 25th Street, at the present terminus, to Army Street, the estimated cost of the work being $10,000. This short extension was determined on in view of the fact that, by constructing the track in advance of the pavement, a saving of approximately $2,500 would be effected in the ultimate cost of the Potrero Avenue extension by avoiding the necessity of tearing up new pavement to lay tracks. Contracts for furnishing the track special work have already been awarded and contracts for the track work will be let at such time as to permit of the track being laid following the completion of the heavy excavation.

Upon the recommendation of this office the Supervisors have appropriated $275,000 from the surplus earnings of the Municipal Railway System for the purpose of constructing the track and overhead work through the Twin Peaks Tunnel from 17th and Market Streets to the junction of Sloat and Junipero Serra Boulevards. The ordinance authorizing this construction also provides for a connection from the west portal of the Twin Peaks Tunnel out Taraval Street to the Ocean Beach. The additional money necessary for completing this portion of the line has not as yet been appropriated. Bids have been invited for furnishing the steel rail for the track work through the tunnel and other contracts

will be let at such times as may be necessary to provide for the completion of the Twin Peaks Line at the earliest date the progress of the tunnel will warrant.

The City Engineer has on several occasions orally and in written reports advised the Board of Public Works and Supervisors of the necessity of preparedness in having adequate transportation facilities arranged so as to reap the fullest benefit to the City immediately on the completion of the $4,000,000 Twin Peaks Tunnel. San Francisco is suffering from lack of adequate rapid transit to the outlying sections, and while the problem is involved and complex, the City authorities have shown so much constructive ability in the past four years in overcoming other obstacles that it is hoped some immediate attention and consistent effort will be given to this pressing subject.

The street railway situation in San Francisco presents a number of serious problems. The track mileage in the City is more than five years behind the needs of the present population. It is difficult to extend the street railway facilities logically or economically because of the fact that all of the railway lines are not under a unified control. The City cannot force the United Railroads to make any extensions nor will the United Railroads make any extensions of their own volition under existing Charter conditions. Many extensions are at present desirable but without suitable connections or transfer arrangement with both the Municipal Railway and the United Railroads system would be of little real benefit. The more carefully the situation is studied the more urgent appears the necessity for the unification of control of all the existing railroad lines, and until this has been accomplished San Francisco will have to put up with a more or less inadequate transportation system. This office at the present time is studying the problem and expects to make a report shortly outlining a logical program for future extensions of the existing Municipal Railway System, but at the best the construction of these extensions will fall short of solving the transportation question in San Francisco, for the solution of this problem requires consideration on broader lines.

The time is fast approaching when a rapid transit system must be considered. This would be either of subway or elevated type, preferably the latter, at this stage of our development, the comparative costs being about $800,000 a mile for the elevated as against $3,500,000 a mile for the subway construction. The first link in a rapid transit system naturally should parallel Market Street connecting with the Twin Peaks Tunnel and with a branch extending south through the Mission in the vicinity of Capp Street.

STATEMENT OF 1910 GEARY AND MARKET STREETS BOND FUNDS.

EXPENDITURES.

Prior to July 1, 1915		$1,948,602.05
From July 1, 1915, to July 1, 1916:		
Ferry outer loop on Embarcadero, Lower Market Street	$ 2,058.50	
Car Barn Extension, Geary Street Railway Tank and Tower Foundation	645.20	
Carn Barn, Second Story, Geary Street Railway	29,170.57	
Carn Barn—Construction Tank and Tower	1,482.00	
Carn Barn Construction—Completing Heating System	341.14	
Extra Parts and Equipment	423.93	
Plans and specifications	306.35	
Total during last fiscal year		$ 34,427.69
Total to date		$1,983,029.74
Available for future expenditures		43,282.16
Total sale of bonds, miscellaneous sources and unsold bonds		$2,026,311.90

TWIN PEAKS TUNNEL.

The general engineering features of Twin Peaks Tunnel were described in the report of the City Engineer for the fiscal year 1913-1914. The project has been advanced efficiently and economically and all of the serious construction problems encountered so far have been solved satisfactorily.

The close of the fiscal year 1914-1915 found the contractor at Station 8+10, some two hundred feet underground at the west end; with 25% of Laguna Honda Station excavated: the vent shaft in the Relief Home Tract fairly well started and the subway section completed on the easterly end. Practically 4,300 feet of completed tunnel has been constructed during the 1915-1916 fiscal year.

An obstruction, presenting some difficulty and successfully handled, occurred about 1800 feet from the west portal. A brick lined water duct of the Spring Valley Water Company constructed in 1865 crossed at a sharp angle 8 feet above the tunnel arch. It was conveyed by means of a by-pass over the completed tunnel. A shaft was sunk, the water duct tapped by a 30" pipe, which ran west 275 ft. in a drift previously driven, crossed the tunnel at right angles and connected with the original duct again. Later the water was permitted to follow the original course. The entire section of tunnel between the west portal and the Laguna Honda Station has been completed.

Excavation for Laguna Honda Station and 22 ft. of tunnel section on each end was done in open cut, the maximum depth being 70 ft. Steam shovels carried the cut to within 15 ft. of rail grade, the sides of the pit being retained by piles. Trenches were then dug by hand for the side walls and footings of the station, after which the concreting was done and then the core of earth was removed. The waste material, a sandy clay, hauled an average distance of 1/3 mile in motor trucks, was used in filling low portions of the valley in which the station is built. Station is completed except the superstructure.

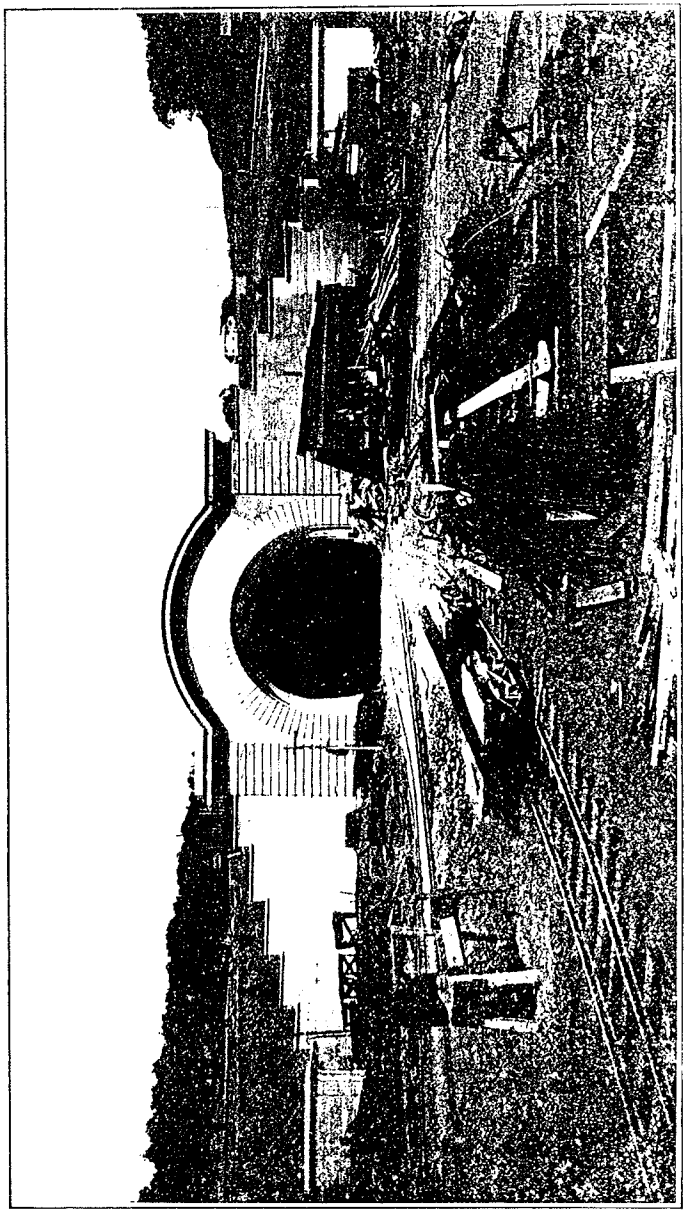
Because of an ascending grade, excavation between the vent shaft and the Laguna Honda Station was started from the former. The shaft when completed will have an inside diameter of 13 ft. but the excavation was made 20 x 32 ft. so as to take in full width of tunnel section and to permit of construction of forms for concreting. From the bottom of this shaft, 100 ft. deep through water bearing sand and timbered with piles held by 12 x 12 bracing and walings hung with steel hangers, a drift was carried 300 ft. westerly at invert grade through sandstone, when it broke through the sandstone into a waterbearing sand, causing 300,000 gallons per day to be lifted out at the shaft. Another drift was then started and kept in the sandstone until after the sand deposit was passed, when the second drift was brought up to line with the first one. Easterly from Laguna Honda tunneling has been projected over 414 ft. on the descending grade toward the vent shaft, the drift previously driven draining the ground penetrated. Concreting follows within free working distance of the finished timber lining.

Excavation for that section between the east portal and a point 500 ft. southwesterly therefrom, was done between two rows of piles and heavy timbering with the necessary cross braces. This ground was a filled in creek bed and the 30,000 cu. yds. of excavation was removed by pick and shovel. This portion of the tunnel has been constructed and the backfilling finished.

Adjacent to the section just described or at Station 97 + 15, the tunneling proper on the east end was started and was driven westerly to Station 87 + 63, leaving to be completed those portions between Station 46 + 57 and 87 + 63 and between Station 46 + 37 and 39 + 00 or 4,843 lineal feet, together with the superstructure of Laguna Honda Station.

In the light of the progress made during the past fiscal year when so many adverse conditions were encountered, and the fact that the greatest portion of the work remaining to be done is in rock, there is not any apparent reason to question the forecast that April, 1917, will see the east and west facings meet and the tunnel completed.

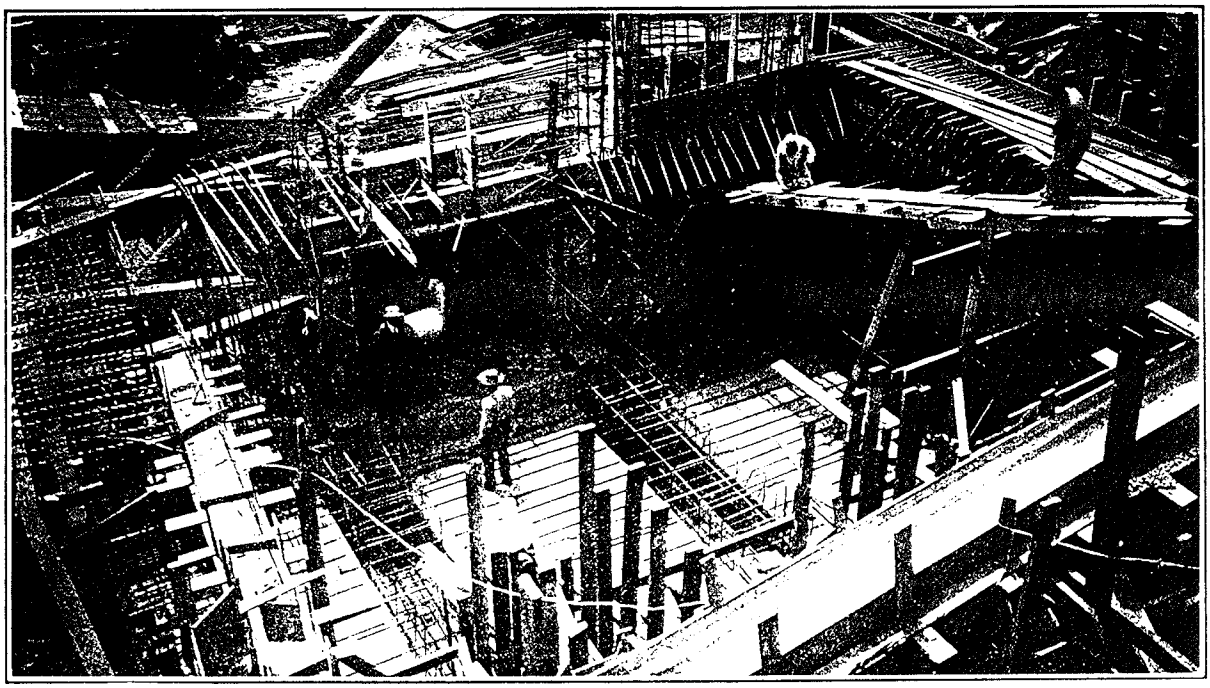
R. C. Storrie & Company, to whom this contract was awarded, for the estimated sum of $3,372,000, have performed work the estimated value of which to date is $2,168,539.38.



West Portal, Twin Peaks Tunnel.

TABLE 1—ALIGNMENT, GRADES AND SUBDIVISIONS

		Grade		Distance on		Curve	
		Ascend	Descend	Tangent	Curve	To	Radius
West Approach	0-00 to 0-83	.015		83.000			
Tunnel Section	0-83 to 17-27.26	.015		1,644.260			
	17-27.26 to 30-31.44	.015			1304.183	Right	5,729.65
	30-31.44 to 30-73	.015		41.557			
Laguna Honda Sta.	30-73 to 33-73	.015		300.000			
	33-73 to 34-30.10		.03	57.103			
	34-30.10 to 36-60.10		.03		230.003	Right	5,729.65
	36-60.10 to 47-13.00		.03	1,052.894			
Ventilating Sta.	47-13 to 47-26.00		.03	13.000			
Tunnel Section	47-26 to 98-64.00		.03	5,138.000			
Taper Connection	98-64 to 100-44.00		.03	180.000			
29′ 6″ Tunnel Sect.	100-44 to 100-74.00		.03	30.000			
	100-74 to 103-76.81		.0287	302.816			
	103-76.81 to 104-96.23		.0287		119.420	Right	1,555.49
	104-96.23 to 108-52.73		.0287		356.500	Right	1,017.95
	108-52.73 to 109-72.15		.0287		119.420	Right	1,555.49
	109-72.15 to 111-45.76		.0287	173.610			
Eureka Valley Sta.	111-45.76 to 114-45.76		.0140	300.000			
Subway Section	114-45.76 to 114-85.61		.0140	39.850			
	114-85.61 to 117-33.56		.0140		247.950	Left	861.37
	117-33.56 to 117-38.76		.0140	5.200			
East Approach	117-38.76 to 119-25.76	.0424		187.000			
				9,548.290	2377.476		



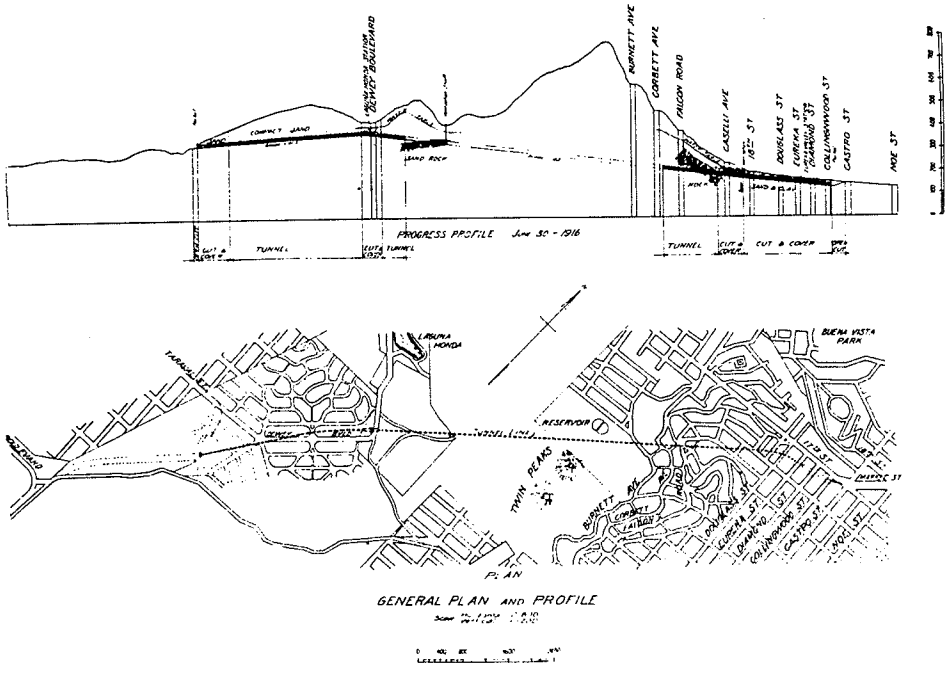
Constructing Laguna Honda Underground Station. The floor will be 62 feet below the ground surface.

Table II sets forth the progress made on these subdivisions during each of the two fiscal years just passed, and the work still to be performed. The profile pictures this progress:—

TABLE 11—ANNUAL PROGRESS.

Subdivision	Method	Station From	Station To	Lineal Feet Completed Prior to June 1915	Lineal Feet Completed June 30, 1915, to June 30, 1916	Lineal Feet To be Compl.	Lineal Feet Grand Total
West Approach	Open Cut	0+00	0+83	83			83
" Portal	"	100% completed					
Tunnel Section	Cut and cover	0+83	5+61	478			478
" "	In tunnel	5+61	8+10	249			249
	"	8+10	30+61		2251		2251
	Cut and cover	30+83	30+61		22		22
		25%		*75			75
Laguna Honda	"	55%			*165		165
" " Sta.		20%				*62	62
" " "					22		22
Tunnel Section	Cut and cover	33+85	34+07		493		493
" "	In tunnel	34+07	39+00			737	737
" "	"	39+00	46+37	*2			2
Vent Shaft	Cut and cover	10%			*18		18
"	"	90%				4106	4106
Tunnel Section	In tunnel	87+63	46+57		952		952
" "	"	97+15	87+63		150		150
" "	Cut and cover	98+65	97+15		180		180
Taper Connect.	"	100+45	98+65		30		30
29' 6"	"	100+75	100+45				
18th Street Vent. Shaft		100% completed					
Subway Section	Cut and cover	111+46	100+75	1071			1071
Eureka Valley Station	"	114+46	111+46	300			300
Subway Section	"	117+38	114+46	292			292
East Portal	Open cut	100% completed					
East Approach	"	119+25	117+38	187			187
	Totals			2737	4283	4905	11,925

* Equivalent in feet.



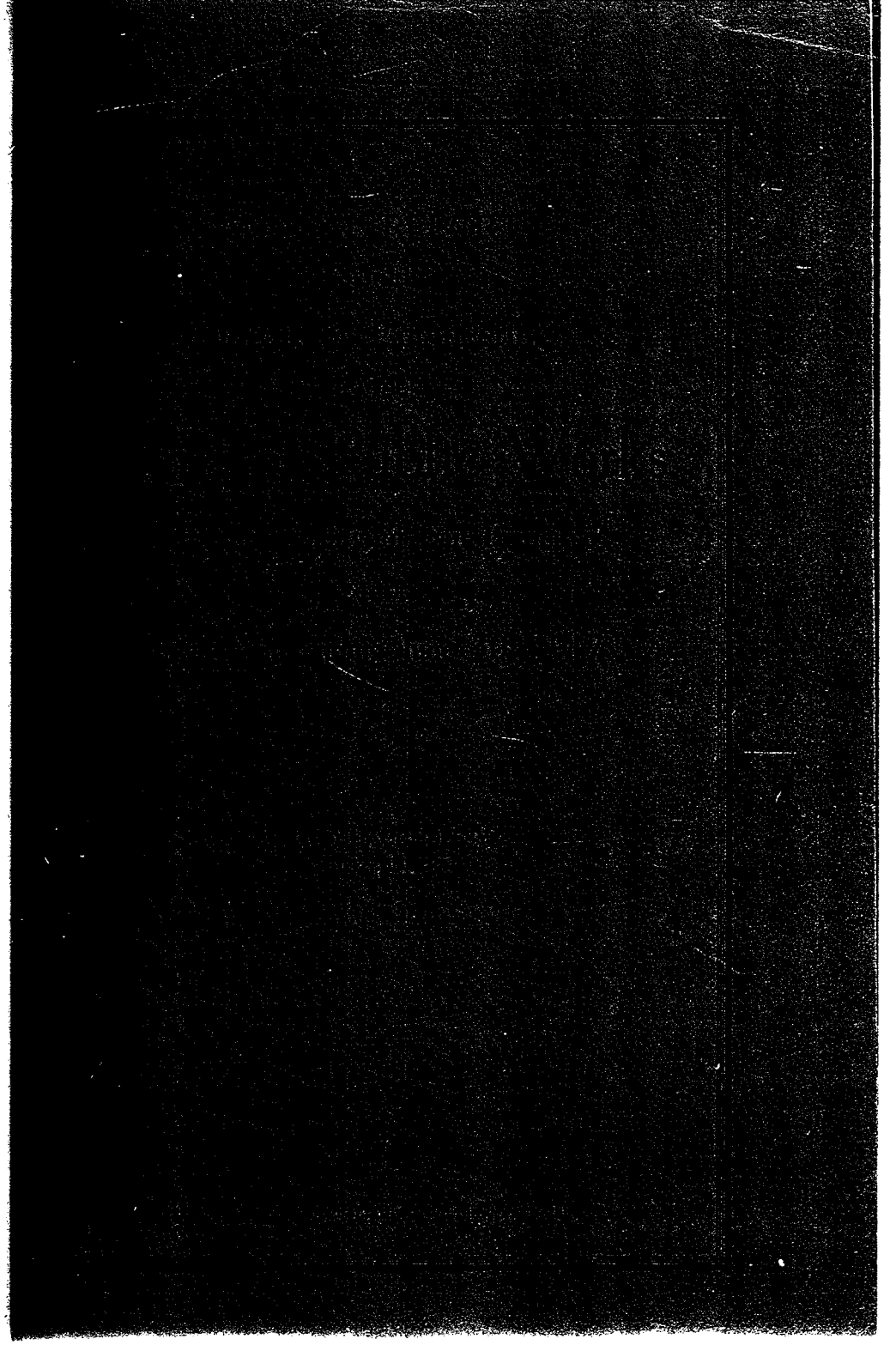
PHOTOGRAPHIC AND BLUEPRINT DEPARTMENT.

The work of the Photographic Department connected with the Bureau of Engineering has been considerably broadened during the past fiscal year. Heretofore most of the work was performed for the Bureau of Engineering but arrangements have been perfected whereby any department of the City government can have photographs made at cost by the Engineer's photographer.

The photographic laboratory has been installed in specially designed quarters on the roof the new City Hall. Equipment of the latest type has been added and the results obtained have proven that the policy of the City doing its own photographic work is economical.

The great advantage that accrues to the City from having this bureau is that plans of contemplated improvements, can be safeguarded better than if the work were done by outside photographers.

[redacted]:



1917

TABLE No. 1.

POPULATION, AREA, AND ASSESSED VALUATION, BY ASSEMBLY DISTRICTS.

DISTRICT	POPULATION			AREA		VALUATION*	
	Total	Per Square Mile of Land	Square Miles of Land	Square Miles of Water	Total Square Miles	Land in Acres	Assessed Valuation of Taxable Land and Improvements
21	36,015	12,955	2.78		2.78	1,779	$ 89,321,280
22	19,746	2,816	7.00		7.00	4,480	11,639,750
23	32,919	6,330	5.20		5.20	3,325	11,441,380
24	36,888	4,822	7.65	†0.58	8.23	4,968	15,107,970
25	42,504	46,708	0.91		0.91	583	15,550,650
26	57,967	38,645	1.50		1.50	954	19,617,920
27	45,801	5,270	8.69		8.69	5,564	26,136,625
28	53,022	15,687	3.38		3.38	2,165	27,179,275
29	45,228	42,269	1.07		1.07	684	24,186,040
30	46,794	38,044	1.23		1.23	787	23,500,110
31	41,334	9,984	4.14		4.14	2,651	35,580,809
32	65,277	56,273	1.16		1.16	741	55,700,040
33	34,467	28,252	1.22		1.22	779	122,410,660
13	557,962	12,148	45.93	0.58	46.51	29,760	$477,372,509

* Assessed valuation for taxation is 50% of appraised valuation.

† Lake Merced.

BOULEVARD SYSTEM.

In advancing the policy outlined in previous annual reports of the City Engineer, work on the boulevard system has been actively prosecuted during the past fiscal year. The following is a description of the work accomplished.

Marina Boulevard:

To have permitted the work of salvage to eradicate all trace of the Panama Pacific Exposition would have been a serious mistake, both from an economic and an aesthetic standpoint. Through the untiring efforts of the Exposition Preservation League, with which the City Engineer co-operated, if present plans are carried out, San Francisco is to have on the Exposition site a choice residential tract. This will be traversed by the Marina Boulevard and marked here and there with gems preserved from the Exposition, namely, the Column of Progress, the California Building, the Marina, Palace of Fine Arts, the Lagoon and the Yacht Harbor.

On the recommendation of this office, Pierce, Steiner, Francisco, Fillmore, Bay, North Point, Beach and Jefferson Streets were declared closed to permit the designing of a subdivision with roadways aligned in graceful curves, more in keeping with the natural attractions of the district than a gridiron street system.

The problems involved in planning the revised street arrangement were numerous. For example, the prevailing winds of the district could not be allowed to sweep along any main artery, and yet it was essential that certain remaining heritages of the Exposition be left visible as termini for properly framed vistas. The problem of proper distribution of traffic through the district was in turn complicated by the necessity of streets of changing direction while it was imperative that the maximum view frontage on the Golden Gate be developed.

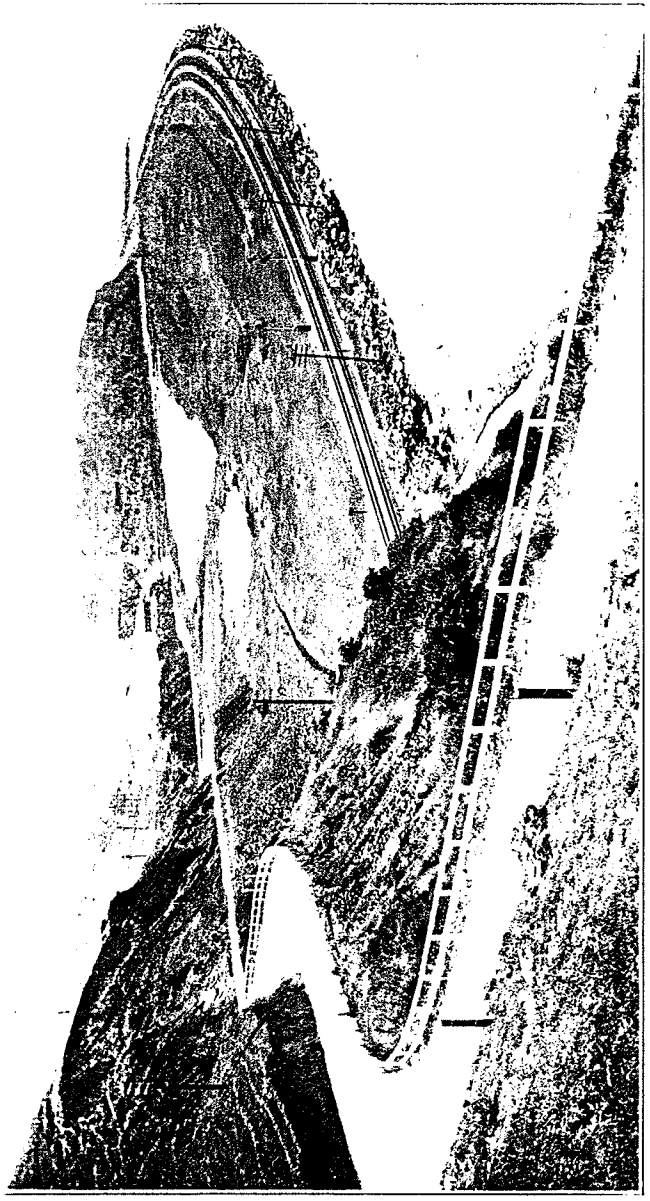
The principal features of the plan which were finally adopted after more than a year's study were a north and south

axis centering on the Column of Progress and an east and west axis passing through the dome of the Fine Arts Building, both of which features will be recalled as ones that dominated their situations in the Exposition. At the eastern end of the east and west axis, centering on the Fine Arts dome, is a plaza approximately one acre in area from which a circular drive or boulevard distributes traffic to the secondary streets in the southern portion of the park. Courts have been planned at uniform intervals along the northern and eastern borders of the park in such a way as to create a succession of features along the two main boulevards while at the same time giving the maximum amount of view frontage looking on the Marina Park and the grounds of the Fine Arts Building. On the southern boundary two business centers have been created from each of which three arteries radiate to the main centers of the residence park.

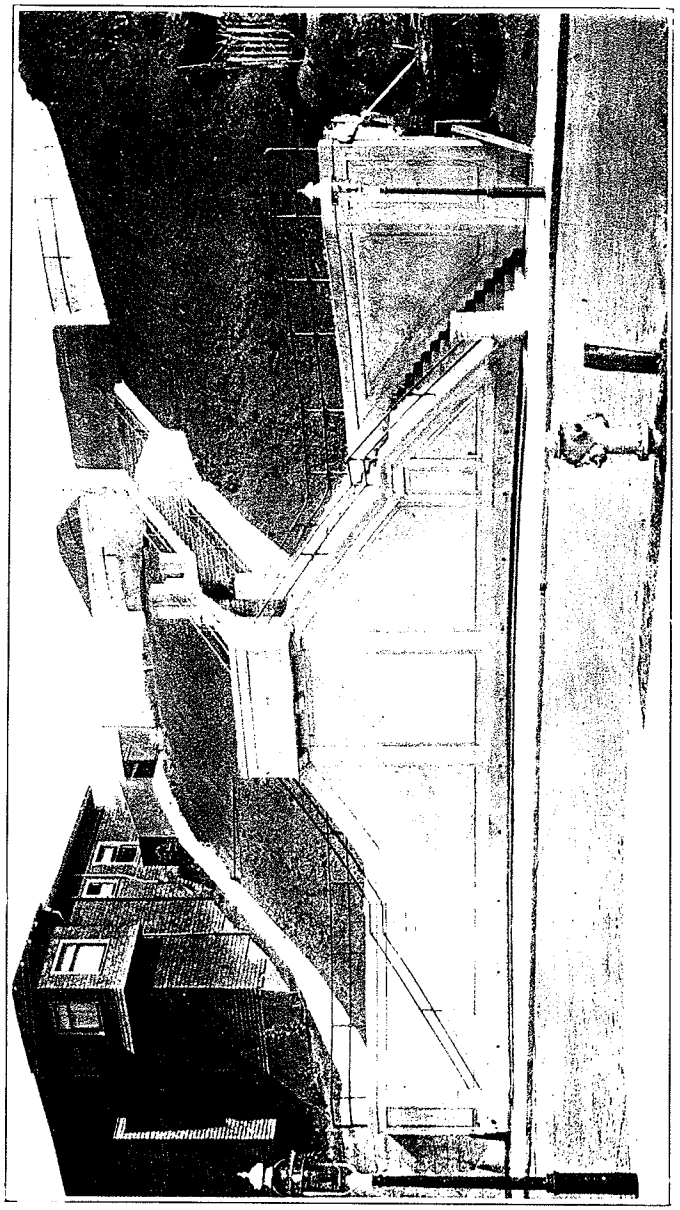
It is proposed that the streets shall be paved and improved in the most modern manner and that all electroliers and other street ornaments shall be of special design. Public utilities such as gas, water and electric power mains will be installed underground. The plan incorporated some twenty odd plazas or parks at street intersections and includes eight or ten interior courts which will be devoted to recreational purposes.

On account of the reluctance of some of the property owners to enter into the scheme, the first section of the project only is now under process of resubdivision. This covers about one-half the area of the whole plot and requires the closure of about 870,00 square feet of existing streets laid out in the rectangular system and the opening of about 860,000 square feet of new avenues and boulevards.

Streets formerly traversing this area were uniformly sixty-eight feet nine inches wide, dividing the district into blocks two hundred seventy-five feet in width by four hundred twelve feet six inches in length. The new streets vary in width from one hundred feet for the Marina Boulevard with a roadway of fifty-one feet down to forty feet for the small intermediate streets.



Bay Shore Boulevard.



Regrade of Cumberland Street Looking Southerly from 14th Street

...ated to open two new streets so that vehicles can ... a southerly and westerly direction to Noe Valley. ...ey for the acquisition of the property necessary for ... projects has been included in the 1917-1918 budget ... City Attorney has commenced action to acquire it.

... the past year grades have been changed, established ... investigated as follows:

... changes—333 blocks, 159 crossings	24 miles
... establishments—109 blocks, 50 crossings	6½ miles
... stigations—138 blocks, 55 crossings	10 miles
Total	40½ miles

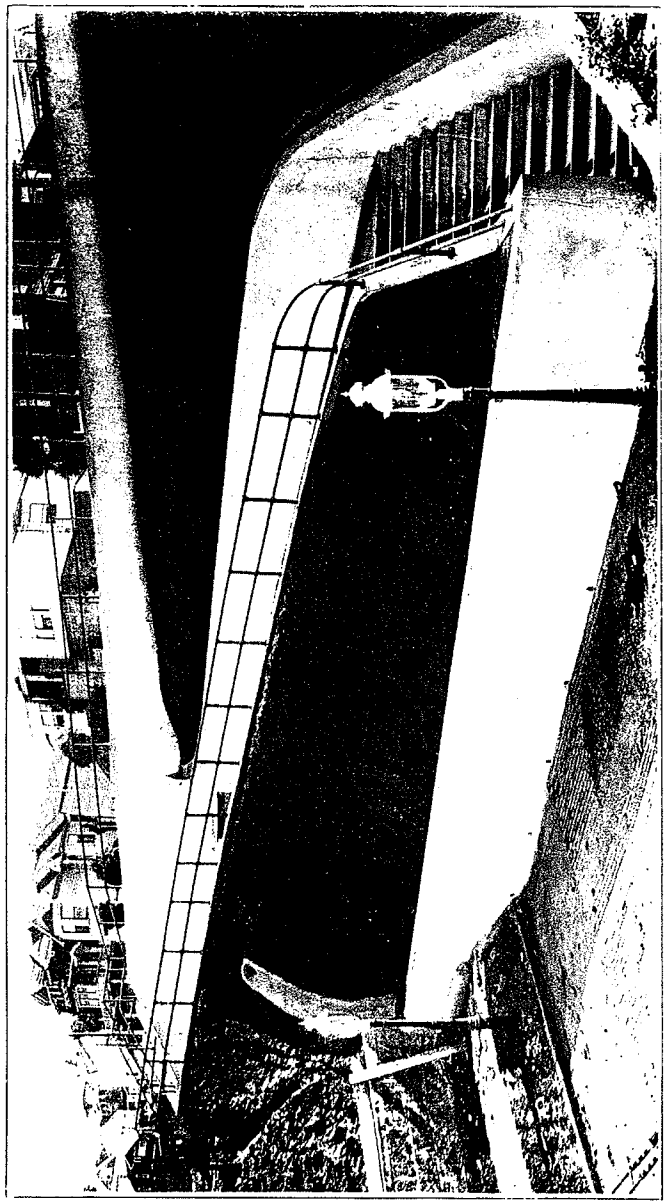
A number of other streets where special treatment in ... s have been made and which will be improved in the ... future, are:

... rchina St. between Twenty-second and Twenty-third Sts.
... St. between Broadway and Vallejo Sts.
... ra to St. between Castro and Diamond Sts.
... St. between Twentieth and Twenty-second Sts.
... ...ies St. between Twentieth and Twenty-first Sts.

... area lying south of Howard Street and east of ... Street comprising about twenty city blocks on an ele... known as Rincon Hill, in former days one of the ... residential districts of San Francisco; but this hill ... a natural barrier to the main lines of traffic between ... of waterfront docks and freight terminals and the ... dependent upon them, comprising the general industrial ... and the business center of the City. Its proximity ... waterfront and the railroads is the cause of the de... ment of this section from a residence district to an in... trial and warehouse center.

The Chamber of Commerce made some preliminary ... s of Rincon Hill in 1912 with a view to suggesting a ... for its regrading.

This office has made a comprehensive study of the prob... and evolved several improvements on the original ... schemes presented.

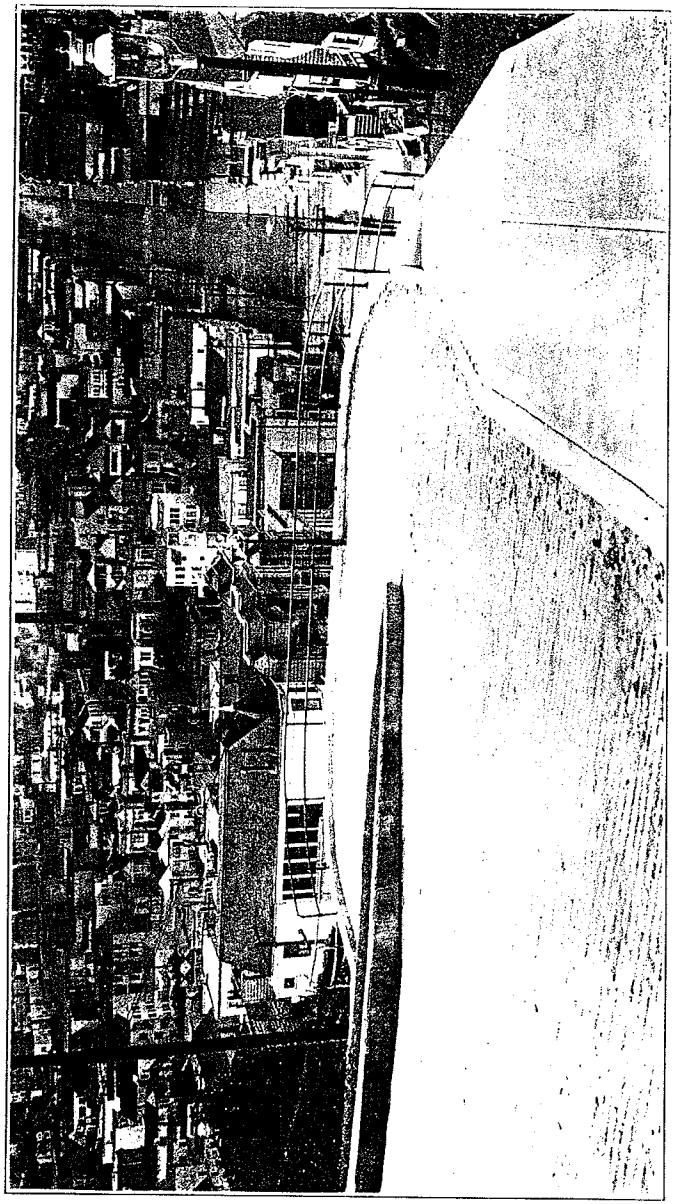


It was found that with a reasonable amount of excavation grades could be established having a maximum of 7 per cent for north and south streets and 4½ per cent for east and west streets. With these street grades established, portions of property east of Second Street and south of Harrison Street could be reached by a projected system of railroad spur tracks terminating in the main Belt Railroad system. Modern motor trucks could easily make the maximum grades on the east and west streets. The hill would no longer be a barrier to heavy traffic and about 46 acres of land with practically no earning power could become a potential income bearing property worth from two to five times its present value.

About 90 per cent of the existing improvements upon the property in this district are wooden structures, many of them obsolete and the owners would welcome an opportunity to replace them with a more substantial type of building. The present condition of the property makes it very difficult for the owners to negotiate loans for any improvements. It was found that the cost of improving the streets could not be sustained by the adjoining property. Close study of the problem shows that the owners of this property would not by any means be the sole beneficiaries by improvements contemplated, but that a very large metropolitan area would be materially benefited. To effect maximum economy it is desirable to grade and control all of the improvements in this area, as one project centrally controlled. Before this can be done, certain changes in the local assessment laws for local improvements must be enacted.

The following is a tabular resume of the principal elements of the Rincon Hill regrade project:

Estimated cost of street work including 1:1 slopes	$1,500,000
Estimated cost of grading private property and restoring improvements	$2,500,000
Present average assessed value private property (60% of full value)	$ .76 sq. ft.
Present value on same basis according to 1916 assessment	$1.25 sq. ft.
Average estimated value after improvements	$2.50 sq. ft.
Estimated possible to spend for improvement to private prop.	$1.25 sq. ft.



Bernal Cut Looking North to 1939 Level

[illegible] proposed reduced district	2,000,000 sq. ft.
	46 acres
[illegible] of property involved in regrade	277 parcels
[illegible] blocks involved in regrade	13 city blocks
[illegible] cost of grading private property and restor-	
[illegible] improvements not incl. 1:1 slopes	$1.25 sq. ft.
[illegible] of materials to be removed	3,386,000 yds.
[illegible] for removing hill estimated at	3-4 years

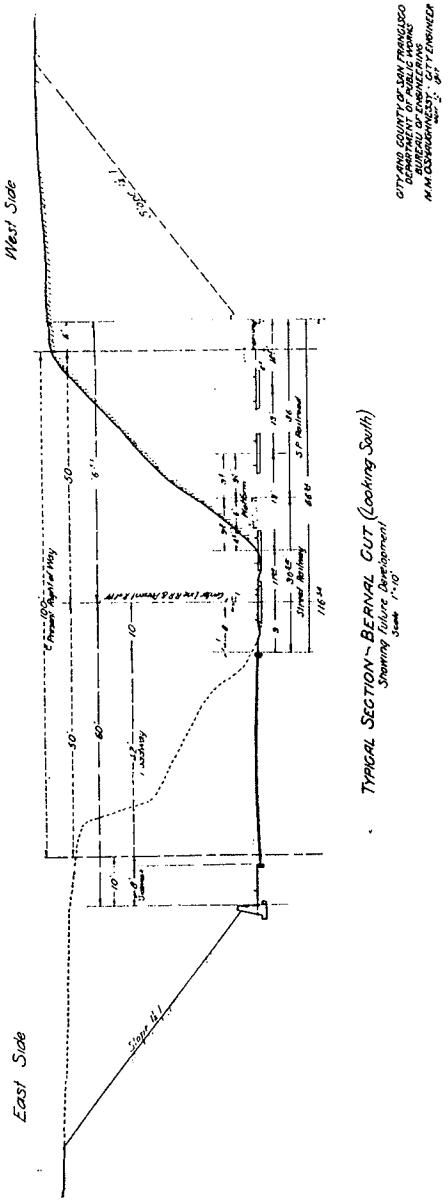
Bernal Cut:

[illegible] bulk of the materials used for street and home im- [illegible] in new subdivisions beyond the Twin Peaks Ridge [illegible] via Mission Street and Ocean Avenue or over [illegible] Street and Lincoln Way. The grades and length of the [illegible] added so much to the cost per ton mile that the [illegible] Bernal Cut could have been built for the saving it [illegible] have effected to date.

One of the conditons made part of the agreement for the [illegible] Pacific Company's new franchise at Third and [illegible] Streets was that the City should be given a right of [illegible] through the existing Bernal railway cut from Randall [illegible] to San Jose Avenue, the Railway Company to do the [illegible] grading to accommodate the paved roadway.

With the rapid growth of our Municipal Railway System, [illegible] tension through this cut of the Church Street Line [illegible] 30th Street to supply needed traffic facilities to the [illegible] side and Ocean View Districts, was planned, and in [illegible] to provide for the street railway, as well as vehicular [illegible] pedestrian traffic, steps have been taken to acquire a [illegible] roadway through the cut than that provided in the [illegible] agreement. Surveys and plans for this improve- [illegible] are complete and necessary lands are being acquired.

This work involves the extension of Dolores Street to [illegible] existing Southern Pacific right of way at Randall Street, [illegible] removal of 232,000 cubic yards of excavation and placing [illegible],000 cubic yards of fill, the removing and reconstructing [illegible] the Southern Pacific tracks to the west side of the wid- [illegible] cut, the paving of a 42 foot roadway and construction [illegible] 8 foot sidewalk with necessary retaining walls on the



east side of cut throughout the 4,450 feet of length. The cost will be approximately $650,000, exclusive of the grading to be done by the Railroad Company.

Cumberland Street, Noe to Sanchez Street:

The regrade of Cumberland Street between Noe and Sanchez Streets and Sanchez Street between 19th and 20th Streets has been completed. Persistent efforts to reconcile the diversified opinions of the people of this district and obtain their agreement to the most logical plan, finally were successful.

Existing street improvements leading to this section, the abrupt nature of its topography and the fact that fronting owners had proceeded with their home building with an utter disregard for any grade plan, injected complications into this problem, requiring the application of some engineering ingenuity for solution.

Sanchez Street at 19th Street was graded and paved while 50 feet south the ground was 16.5 feet higher. Cumberland Street at Sanchez Street was graded and paved while 20 feet west the ground was 31 feet higher. Sanchez Street at Cumberland Street was improved with an elevation at the northerly line of 198.83 and at the south line of 209.17 where the ground rose sharply to an elevation of 240 feet. Twentieth Street at Sanchez was an improved street having an elevation of 240 feet the east side of Sanchez Street conforming to official grade, while the west side was 25 feet higher.

The only inlet adaptable to changes that would permit of vehicular traffic was via Twentieth Street. This will also serve the district south of Twentieth Street between Church and Noe Streets. By a system of retaining walls and stairways pedestrians may reach this region at Sanchez and Nineteenth Streets, Cumberland and Noe and Cumberland and Sanchez Streets. The general street design of roadways and walks in the same plane was precluded here, the difference in elevation between houses on opposite sides of the street being from 7 feet to 19 feet. To keep at a minimum

the height of retaining walls, at the property line on the l
side and still not leave the homes on the low side in a holl
the space between curbs was designed with elevated or d
pressed sidewalks and terraces. These terraces vary fr
level parking spaces to sloped surfaces having a pitch of
feet in a width of 11 feet and 13 feet, according to grou
conditions. As planned, the majority of retaining walls d
not exceed 6 feet in height. Three were constructed at a ma
mum height of 12 feet. In some instances where the fronts
the houses were back of the property line, the terraces we
extended into the property thereby doing away with neces
of a wall. A 2½-foot cross warp in the roadway, was resor
to to cut down heights of walls.

Sanchez Street from Twentieth to Cumberland Street
paved with 2 inches of asphalt on a 6 inch concrete base o
scending on a 5.3 per cent grade. The crossings of Sanch
and Cumberland Streets is similarly paved. From the nor
line of Cumberland to 89 feet northerly, the grade of Sanch
Street is 16.6 per cent and thence to Nineteenth Street it
28 per cent except the parking space and wall where the gra
is lessened to permit vehicles to turn. Hillside brick pav
ment was used where grades were sufficient to warrant th
increased cost.

On Cumberland Street west of Sanchez Street a 9.5 p
cent grade obtains for 155 feet, a 4 per cent grade for the ne
100 feet and a 15 per cent grade for the remainder to X
Street, except around the island park at Noe Street where th
grade is reduced to allow traffic to turn.

Concrete in walls and stairs was a 1-2-4 mix deliver
from mixer to forms by gravity chutes. Six inch tile drai
imbedded in broken rock were placed back of all walls an
concreted to weep-holes at proper intervals.

Galvanized iron railings are placed on walls where nece
sary. Special fittings had to be cast for all this work on a
count of the many curves and breaks in grade. Hardly an
two fittings were alike.

Excavation was performed by a ¾ cubic yard steam
except at Sanchez and Nineteenth Streets where the
grade made the use of the shovel dangerous. Here a
was erected and 4-horse Fresnoes scraped the material
gates which led into the trap, whence it was loaded into
trucks. Over 20,000 cubic yards loose measurement was
in this manner.

Now that this section has been made accessible and that
streets present an inviting appearance, the wonderful
to be obtained from this height, the ideal climatic condi-
existing there, and the proximity of the Church Street
of the Municipal Railway System, will all be potent fact-
in inducing people to locate. Property enhanced substan-
beyond its original value since the improvement was

Leavenworth Street and Chestnut Street:

Francisco Street between Hyde and Leavenworth Streets
elevation of approximately 130 feet before the recent im-
of Leavenworth Street between Chestnut and Fran-
Streets, has been practically inaccessible. The only ap-
thereto, over Hyde Street between Chestnut and Bay
was on a 20.5 per cent grade with a very dilapitated
stone pavement.

A few years ago new grades were established to provide
convenient approach to this district. The first unit of this
was completed in December, 1914. This con-
of part of a retaining wall swinging from near the mid-
of the south line of the crossing of Francisco and Leaven-
Streets to the north curb at the west line and a stair-
on the northeast face of the wall leading from the upper
to the lower levels of the crossing. As then finished, ready
ingress and egress was afforded pedestrians, but a second unit
of this work had to be installed to accommodate vehicles. This
consisted of the continuation of the existing retaining wall
southerly in Leavenworth Street parallel to the property lines
for a distance of 187.5 feet dividing the street into two levels.

MUNICIPAL RAILWAYS

Church Street Line:

The Church Street Line of the Municipal Railway com. menced operation on the 11th of August, 1917. The placin. of this road in operation marks the completion of the fina link of the extensions contemplated under the Bond Issue o 1913, when the citizens of San Francisco voted $3,500,000 fo extending the Municipal Railway System by the constructio of some 12 miles of double track and the purchase of th Presidio & Ferries Railroad or the so-called Union Stree Line comprising 3.78 miles of double track.

In the last Annual Report of the Bureau of Engineerin there was presented in detail a chronology of the public pro ceedings had in connection with the construction of th Church Street Line, so that it is sufficient here but briefly t touch upon this earlier history.

The Church Street Line contemplated under the provi ions of the Bond Issue consisted of an extension of the M nicipal Railway System from Van Ness Avenue and Mark Street, out Market Street to Church and over Church Stre to 30th Street. For a number of reasons, in constructing th road, it was considered necessary to divide the line into thre sections:

Section "A" from Van Ness Avenue and Market Stre to 16th and Church Streets; Section "B" from 18th an Church Streets to 22nd and Church Streets; and Secti n "C from 16th and Church Streets to 18th and Church Stree and from 22nd and Church Streets to 30th and Chur Streets.

Section "A" included that portion of the line in whic it was anticipated that legal difficulties and obstacles wou be placed in the City's way by the United Railroads. Se tion "B" covered that portion of the road where a diversi was made from Church Street through Mission Park and private right of way, which involved the acquisition by co demnation or purchase of a large number of small parce

of land, and Section "C" comprised that portion upon w h no unusual conditions existed.

Section "C" was completed April 29, 1916. Section B was completed June 28, 1916, and Section "A," the last link to be finished, was completed on the 1st of August, 1917.

This latter contract was awarded to the Western Motor Company on the 16th of March, 1917. The com- pletion of this contract was contingent upon the delivery of the track special crossings of manganese steel which had to be manufactured and delivered from the East, after the last legal obstacle in the way of the construction of the line had been removed.

In order to expedite this work to the fullest degree, this office had prepared the necessary plans and specifica- tions and the Board of Public Works had advertised for bids and entered into a contract with the United States Steel Prod- uct Co for the delivery of these special track castings within days after the receipt of the order. This arrangement in gave the City an option on this material, which was to be exercised in the contingency of a favorable decision from the United States Court, to which the United Railroads had appealed for an injunction to prevent the construction of parallel tracks on Market Street and on Church Street.

On January 18, 1917, Judge Wm. H. Hunt, of the United States District Court handed down a decision of the most momentuous import to our Municipal Railway System. In his decision, in which he denied the injunction sought, he stated:

> It is accepted that the destruction of the franchise is not pos- sible but even so, in the complexities of modern society new condi- tions present themselves which may call for the safeguarding of the public interest in a way which justifies the application of the doc- trine that the police power may extend to all great public needs."

And further:

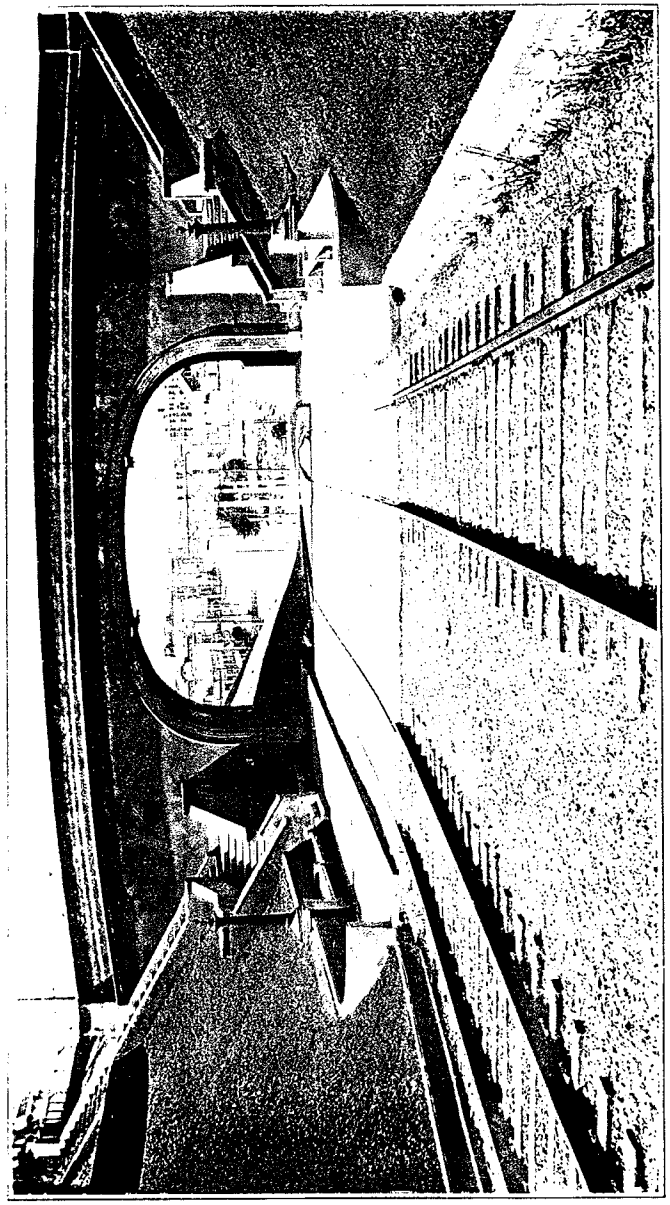
> "There being no statutory rule against one street railway com- pany from crossing the tracks of another, I do not find that compen- sation must first be paid for the crossing."

In his opinion, he quotes, from the case of the Consolidated Traction Company vs. the South Orange and Maplewood Traction Co., in which the Court held that,

"Although the crossing necessitates some actual interference with tracks as constructed and to some extent changes thereafter the exclusive use by the one company of its crossings, still such changes are the necessary result of the development of the method of operating electric roads at their points of crossing, and are such as are made necessary as the best and safest methods now attainable for the safety and convenience of the public in the operation of both roads at the point of crossing: that they are changes and burdens in the use of its tracks and trolley system to which the original right to lay and construct them was necessarily subject."

Immediately upon the receipt of Judge Hunt's decision, the United States Steel Products Company was ordered to proceed with the manufacture of the crossings for Section "A" of the Church Street Line. While these crossings were being manufactured, the specifications were prepared and bids advertised for the construction of the track work on this section and also for the erection of the poles and overhead electrical work.

In connection with the question of poles for this section of the line, this office took up with the United Railroads the question of entering into an agreement with that Company for the use of the existing poles on Market Street and on Church Street in order to avoid the unnecessary duplication of poles on these streets, suggesting as a basis for the agreement the so-called Joint Pole Agreement which is in effect between the various public service corporations of the City, under which any company is allowed to use the poles of another corporation by paying the proportional cost for the pole, or other equitable arrangement. This the United Railroads refused to do, whereupon the City entered into a contract for the erection of a second set of poles on Market Street from Van Ness Avenue to Church Street and on Church Street from Market to 16th Street. While these poles were being manufactured, but before they were placed in position, the Chairman of the Public Utilities Committee, Supervisor Edward I. Wolfe, appealed directly to Mr. Lilien-



Mission Park Bridge—Church Street Municipal Railway.

thal, President of the United Railroads, to reconsider his objection and allow the City to use the United Railroads' poles. Mr. Lilienthal, after further review, yielded and the Contractor was directed not to set the poles.

After the award of the contract for the construction of Section "A," when the Board of Public Works requested the Supervisors to appropriate the amount of the contract an effort was made by individuals representing different interests to effect an agreement between the City and the United Railroads, which would obviate the necessity of constructing these additional tracks on Market Street. The consideration of these questions by the Board of Supervisors consumed several weeks before they decided to proceed with the construction of outer tracks from Van Ness Avenue to Church Street, but with the expressed intention of a number of the members of the Board that the further construction of tracks on Market Street, that is, between Kearny Street and Van Ness Avenue and between Church Street and Castro Street, would not proceed until further effort had been made to reach an agreement looking to the use of the United Railroads tracks on this portion of Market Street.

Twin Peaks Tunnel Line:

R. C. Storrie & Co., who have the contract for the construction of the Twin Peaks Tunnel, completed their work early in July, 1917, and the 14th day of July was set as the day to celebrate the completion of the Twin Peaks bore. At the completion of the dedication ceremonies the construction of the railway through the Twin Peaks Tunnel will be commenced.

The contract for the construction of the railway through the tunnel was awarded to Eaton & Smith for the sum of $80,467.25. This contract is for double track overhead electric railway from the East Portal of Twin Peaks Tunnel near Castro Street, through the tunnel, and over West Portal Avenue to the junction of Sloat and Junipero Serra Boulevards. The trolley wire, rails, ties, tie plates and other track material for this work are being furnished by the City, having been purchased under contract over a year ago, in order to assure their being on hand when the work was ready to [illegible].

The type of track to be installed through the tunnel is what is known as ballasted open track construction. The rails weigh 70 pounds per yard and are in 60 foot lengths through the tunnel. This longer length of rail was adopted for use in the tunnel to secure smoother, quieter operation by the reduction of the number of joints. The longer length rail has the further advantage of reducing the cost of maintenance and of bonding. This length of rail is not generally adopted for railroad construction in the open as the allowance at the joints to care for expansion due to temperature changes in exposed work becomes excessive. This objection does not hold in the tunnel, where there will be comparatively small temperature changes, permitting the joints to be laid tight.

The type of overhead trolley work is what is known as the catenary suspension type. In this construction as adopted the trolley wire is supported at 12 foot intervals from a separate steel cable ⅜ inch in diameter, which is stressed in tension to approximately 1800 pounds. The frequent points of support maintain the trolley wire at practically a uniform elevation above the track, thereby avoiding the sparking and wear found at the points of support in the ordinary type of construction. This will also in a large measure reduce noise in the tunnel by eliminating any rigid connection between the trolley wire and the suspended ceiling in the tunnel.

The construction of this Twin Peaks Tunnel line will be completed on or before December 1, 1917, and it is hoped that by the time it is completed some solution will be had for operating cars directly down Market Street and connecting with the existing lines west of the Twin Peaks.

The schedule time for cars through the Tunnel will be 6 minutes and 23 seconds eastbound, and 7 minutes 16 seconds westbound, allowing for stops at both stations.

The running time of the United Railroads cars from Ea and Market Streets to the Ferry at the present time is minutes. If outer tracks are constructed on Market St to Kearny Street this time will be reduced at least 3 minut This will make the running time from Sloat Boulevard the Ferry 26 minutes, or about 20 minutes less than t time now required.

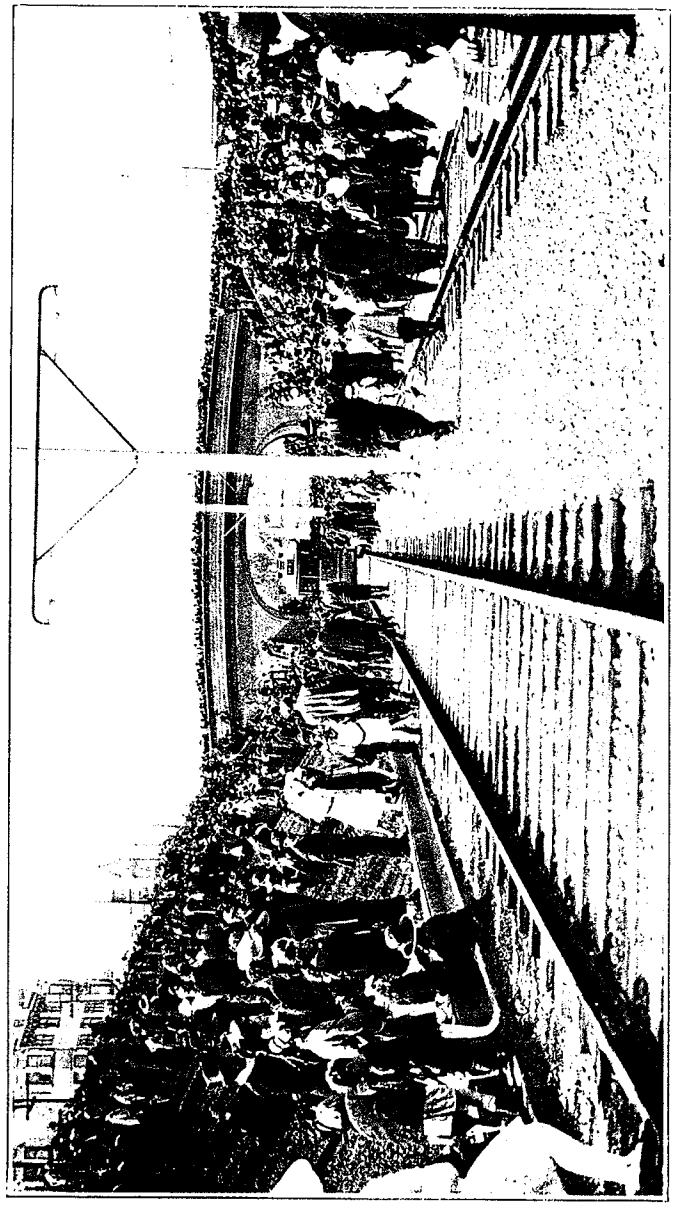
Four-Tracking Market Street:

When the routes for the extensions to serve the Exp sition were determined upon prior to the bond election 1913, the City Engineer realized that there would be serio opposition encountered to the construction of tracks on Ma ket Street from Van Ness Avenue to Church Street. T guard against this the enacting ordinance was so frame as to permit a suitable connection from Van Ness Aven and Market Street to Church Street, it being in mind event of an adverse decision of the Courts, that this co nection could be made by leaving Market Street after tw blocks.

This Department made an effort to start the constru tion of this section of the line first, in order that the leg difficulties might be met and solved in advance of construct ing the remaining portion of the work. This idea met wit the opposition of certain members of the Board of Supe visors who desired to have the plan for overcoming th grades on Church Street adopted first. The result of thi departure from the Engineer's recommendation was to hav Section "B" and "C" of the Church Street road, that is the portion south of 16th Street on Church Street, com pleted and lying idle for one whole year awaiting the d termination of the City's rights on Market Street.

After the above condition was created, this Departmen evolved a plan under which, by a temporary transfer agre ment made with the United Railroads, the Church Stree Line could be operated from 30th to Market Street. Thi temporary transfer agreement was rejected by the Board

of Supervisors and upon the United Railroads refusing to allow a connection to be made with their tracks at 16th and Church Streets, after having agreed to sell to the City one-half interest in those tracks on Church Street, the Board of Supervisors passed a resolution directing the Board of Public Works to proceed with the construction of outer tracks on Church Street from 16th to Market Street and on Market Street from Church Street to Van Ness Avenue. The Supervisors further, by resolution, directed the Board of Public Works to prepare plans for the construction of outer tracks on Market Street from Kearny Street to Van Ness Avenue and from Church Street to the East Portal of Twin Peaks Tunnel. Thereafter in order to bring the matter into the Courts and secure the earliest possible decision as to the City's rights on Market Street, upon the recommendation of the City Engineer, the Board of Public Works adopted a resolution authorizing the City Engineer to construct outer tracks on Market Street and Church Street by day labor. Immediately following the passage of this resolution work was commenced at the intersection of Van Ness Avenue and Market Street to install a crossing in the United Railroads tracks. On the following day an injunction was served on the Board of Public Works and the City Engineer restraining them from further work on this construction, and on August 22nd, 1916, Judge Wm. H. Hunt, United States District Court, commenced the hearing of the case, which hearing was completed on the 25th of August. On the 18th of January, 1917, as noted before, a decision favorable to the City was returned. As before referred to, following the award of contract for Section A of the Church Street Line, when the appropriation was requested to cover the contract price, considerable opposition developed to the construction of outer tracks on Market Street. After extended deliberation the Supervisors finally appropriated the money so that the contractor could proceed with that portion of the work from Van Ness Avenue to Church and 16th Streets.



Dedication Ceremonies, Church Street Railway

At the time the question of appropriation was being considered by the Board of Supervisors, Mr. Lilienthal, President of the United Railroads, made a proposal under the terms of which the City would be allowed to operate its Church Street cars over the Market Street tracks of the United Railroads to Van Ness Avenue on a mileage basis, and to route the Twin Peaks Tunnel cars down Market Street to the Ferry. This offer was rejected by the Board of Supervisors as far as its application to Section "A" of the Church Street road was concerned, but with the idea and the expressed intention of a number of the Board that when the question of appropriations for constructing the outer tracks connections on Market Street from Van Ness Avenue to Geary Street and from the Tunnel to Church Street already authorized by Ordinance of the Board of Supervisors should come up, further consideration would be given to the offer of the United Railroads. In the meantime, as time was running against the consummation of our transportation plans, it was essential that some decision be reached as to the policy to be adopted in order that the necessary material could be purchased. To develop a definite policy and bring the matter to a focus, this office took such steps as were within its province and certain negotiations were had with the United Railroads. The exchange of correspondence on this four-tracking proposition is herewith presented in full.

UNITED RAILROADS OF SAN FRANCISCO

58 Sutter Street

President's Office

San Francisco, January 29, 1917.

Honorable the Mayor and Board of Supervisors
of the City and County of San Francisco.

Dear Sirs: Not alone as President of the United Railroads but more particularly as a citizen who knows that he is always ready to place the public welfare above private interests, I earnestly recommend to your Honorable body the postponement of the proposed action to parallel the tracks of the Company until at least the City Engineer and our General Manager will have had an opportunity to

TWIN PEAKS TUNNEL

On April 5, 1917, crews working on the East and West headings of the Twin Peaks Tunnel met underground 6,000 feet from the easterly portal. When the headings met it was found that the alignment and grades of the tunnel checked to within one-half an inch.

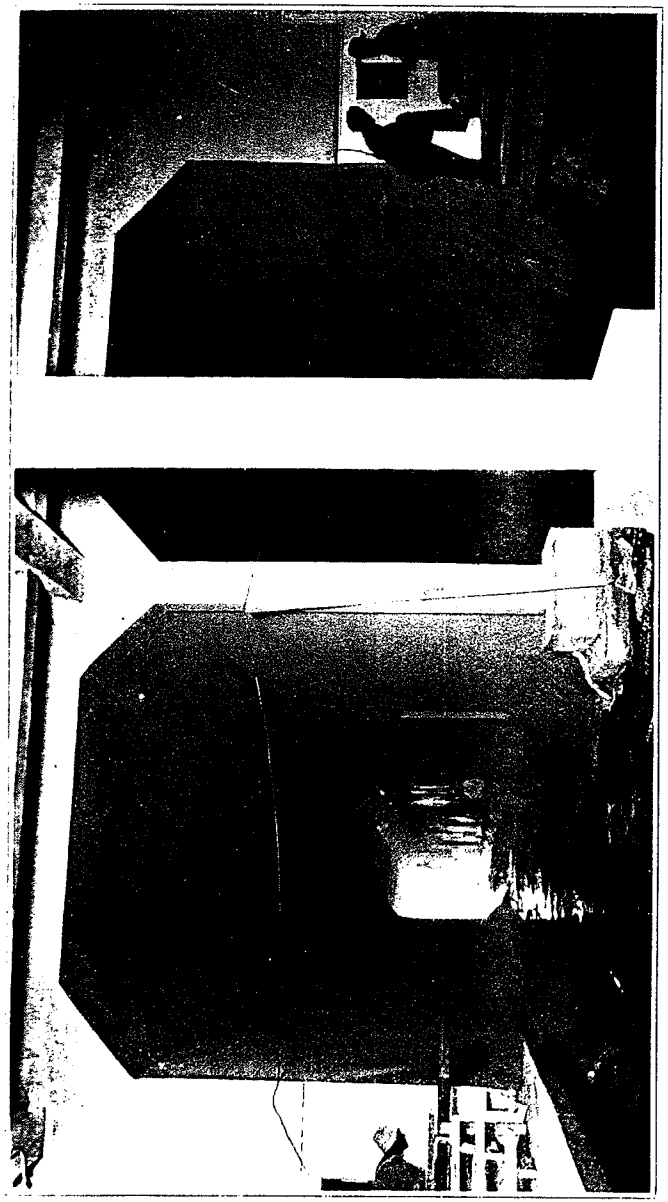
On July 14, 1917, the tunnel was finally accepted by the Mayor and city officials, with appropriate ceremonies to celebrate the completion of the work.

Construction was started on this project on November 30, 1914, and has progressed steadily, sometimes under very adverse conditions.

The material encountered between the west portal and Laguna Honda Station was sand, excepting an intrusion of chert and incipient sandstone for about 300 feet. The excavation through this portion progressed at the rate of 12 to 15 feet a day over three 8-hour shifts. Between the station and a point 200 or 300 feet beyond the shaft, the tunnel passed through water-bearing sand above a clay stratum and the progress of the excavation was much slower. The large volume of water required the constant running of several centrifugal pumps until the excavation was finished and the drains in the center of the tunnel from both ends connected up.

At the east end of the tunnel, the excavation for several hundred feet was through clay and gravel, and then passed into chert and altered sandstone. The chert was in layers with clay strata between and required the same heavy timbering as the softer material. A considerable flow of water from underground springs appeared in this section but did not hinder the work to any extent. Open joint pipe drains were carried forward beneath the footings and materially aided in keeping the tunnel dry.

After passing through the altered sandstone, a body of very hard sandstone was penetrated. This was found to be



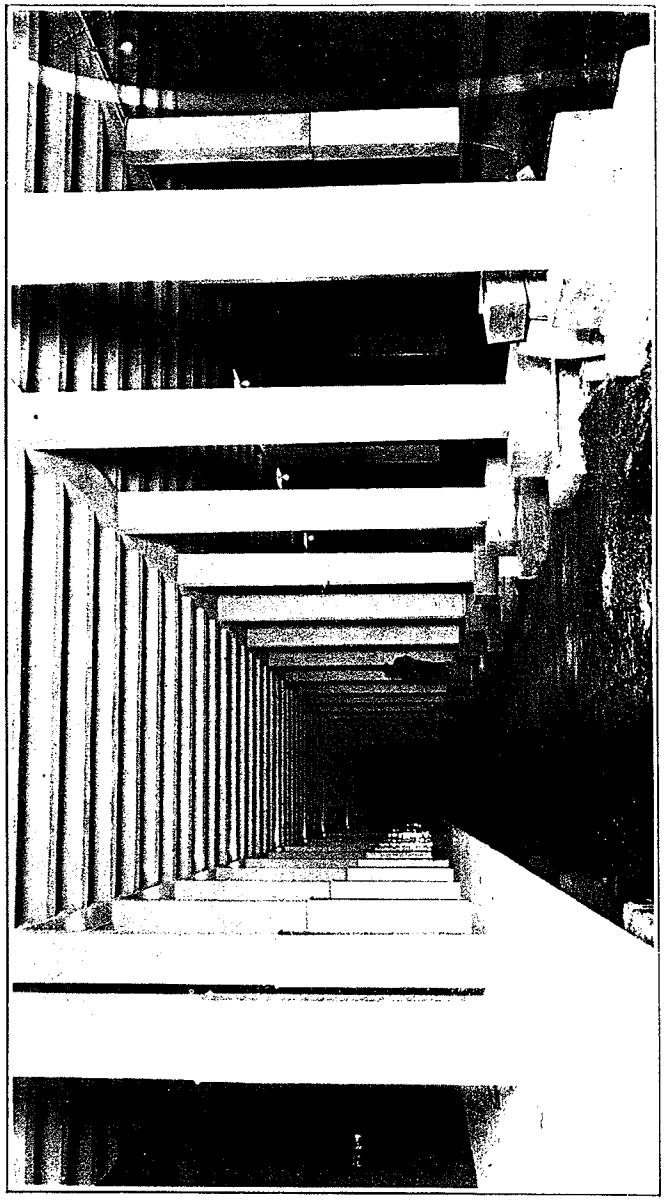
Approach to Eureka Valley Station.

an excellent rock for use in concrete and the installation a crushing plant was planned but the body of sandstone petered out. Serpentine was then encountered and continued for a length of 4,000 feet up to the water-bearing sand near the ventilating shaft. Throughout the serpentine, the open timbering was used and the excavation carried forward from 10 to 14 feet in 24 hours.

The following table shows the materials penetrated, methods of excavation and types of timbering and lining used throughout the tunnel:

TUNNEL DATA

From Station	To Station	Material Penetrated	Excavation	Type of Timbering	Type of Reinforced Concrete
0+85	5+63	Sand West end	In open cut	None	22" arch section
5+63	30+55	Sand West end	In tunnel from west	Solid	22" arch section
30+55	30+83	Sand West end	In open cut	Piling and bracing	22" arch section
30+83	33+83	Sand West end	In open cut and trenching	Piling and bracing	Station arch section
33+83	44+69	Water-bearing sand	In tunnel from west	Solid	22" arch section
44+69	46+37	Water-bearing sand over clay	In tunnel from shaft	Solid	22" arch section
46+37	46+57	Water-bearing sand over clay	As part of shaft	Spiling and walings	Special arch shaft sub-structure
46+57	52+00	Water-bearing sand, clay, sandstone and shale	In tunnel from shaft	Solid	22" arch section
52+00	54+00	Serpentine	In tunnel from west	Solid	22" arch section
54+00	59+20	Serpentine	In tunnel from west	Solid arch spaced posts	18" arch section
59+20	87+00	Serpentine	In tunnel from west	Solid arch spaced posts	18" arch section
87+00	89+60	Sandstone	In tunnel from west	Solid arch spaced posts	18" arch section
89+60	97+15	Chert, clay and gravel	In tunnel from west	Solid	22" arch section
97+15	98+64	Sandy clay and gravel (water course)	In open cut	Piling and bracing	22" arch section
98+64	100+44	Sandy clay and gravel (water course)	In open cut	Piling and bracing	22" arch section—taper
100+44	100+74	Sandy clay and gravel (water course)	In open cut	Piling and bracing	22" arch section—extra width
100+74	103+00	Sandy clay and gravel (water course)	In open cut	Piling and bracing	Double tube, flat top
103+00	111+45	Sandy clay and gravel (water course)	In open cut	None	Double tube, flat top
111+45	114+45	Sandy clay and gravel (water course)	In open cut	None	Eureka Valley Sta. flat top with steel frame
114+45	117+41	Sandy clay and gravel (water course)	In open cut	None	Double tube, flat top
117+41	120+00	Sandy clay and gravel (water course)	In open cut	None	Portal and approach walls



PROGRESS DATES

- West Station 0+85—Station 5+63:
  - 1914 Excavation started;
  - [illegible] 12, 1915—Excavation completed.
- Excavation—Westerly Section:
  - [illegible] 24, 1915—Excavation started Station 5+63;
  - [illegible] 3, 1915—Bottom drift started, Station 12+45;
  - [illegible] 7, 1916—Bottom drift reached Laguna Honda Station excavation, Station 30+83;
  - [illegible] 15, 1916—Excavation and timber reached Laguna Honda Station.
- Honda Station (sub surface structure):
  - [illegible] 15, 1915—Excavation started;
  - [illegible] 7, 1916—Concrete (except invert lining) completed.
- Shaft Excavation:
  - [illegible] 2, 1915—Excavation of shaft started—Station 46+47;
  - [illegible] 16, 1916—Bottom drift west from shaft started;
  - [illegible] 22, 1916—Bottom drift west from shaft connected up with drift from west—Station 42+31;
  - [illegible] 18, 1916—Timbering west from shaft connected up with timber from west—Station 45+08;
  - [illegible] 22, 1916—Bottom drift east from shaft started;
  - [illegible] 6, 1916—Top drift east from shaft started.
- East East Station 97+15—Station 120+00:
  - [illegible] 30, 1914—Changes in street alignment and sewers, etc., started;
  - [illegible] 5, 1915—Excavation of approach started;
  - [illegible] 1917—Open excavation completed.
- Excavation—Easterly Section:
  - [illegible] 8, 1916—Tunnel excavation started—Station 97+15;
  - April 5, 1917—Top drifts holed through—Station 59+09.
  - May 31, 1917—Bench and segments connected—Station 59+47;
  - July 2, 1917—Concrete lining completed.

A daily flow of over 200,000 gallons of water was encountered during the tunnel construction. To collect this supply and furnish the Relief Home with a water supply a collecting chamber was constructed by driving a drift southerly at right angles to the tunnel line beneath the Relief Home, for a distance of 130 feet. This chamber was approximately 5 feet by 7 feet in size, in a sand formation near the contact with the clay deposits. It was filled in alternate sec-

tions with porous tile and gravel, with open joint drains la on the floor to a basin near the tunnel. A well was also sun near the air shaft to connect with a sump at this point and a pump installed to raise the water to the tanks of the Rel Home.

The principal features of the Twin Peaks Tunnel ar summarized as follows:

LENGTH: 12,000 ft. (2.27 miles).
Portion in tunnel, 8,800 ft.
Portion in cut and cover, 3,200 ft.

DISTRICT BENEFITTED: West of Twin Peaks Ridge, 1,153 acres, assesse $3,398,973.
East of Twin Peaks Ridge, 660 acres assesse $595,316.

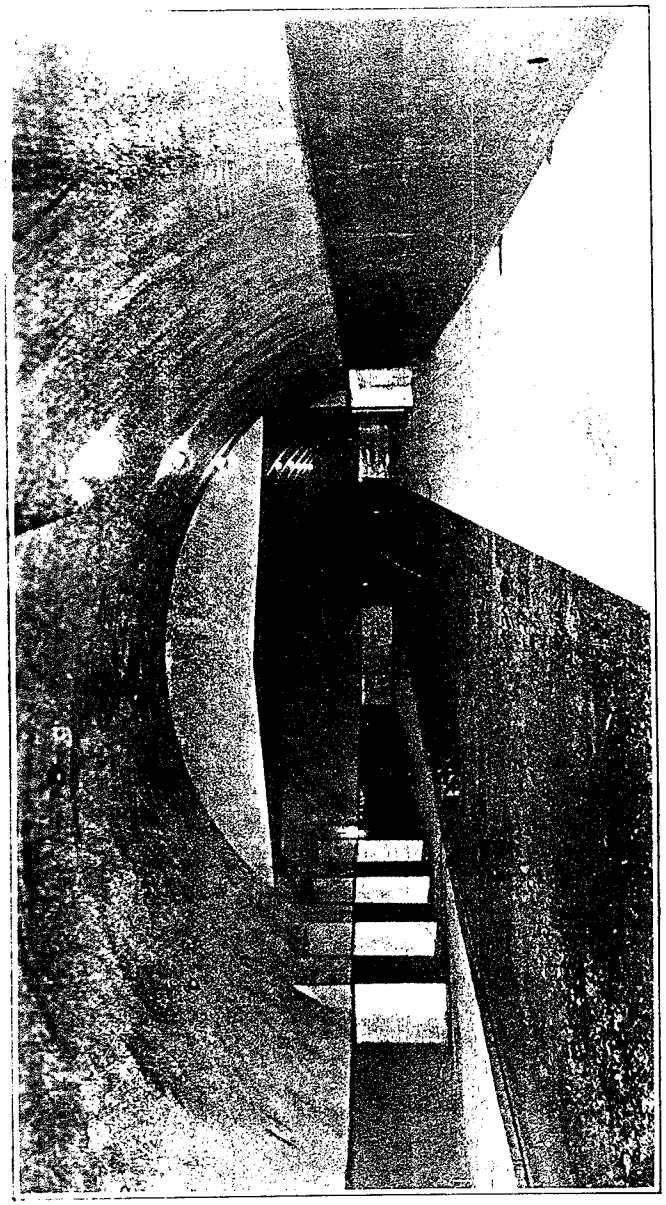
SHAPE OF SECTION: Width, 25 ft.
Height, Total 25 ft.
Net clearance above rail, 15 ft.

Thickness of	Double Tube Subway Section (1365')	Section in Soft Earth (5903')	Section in Soft Rock (3556')
Ceiling slabs	18"		
Arch		22"	18"
Walls	21"		
Walls at spring		33"	33"
Invert	20"	18"	None

GRADES AND CURVES: Maximum grade of tunnel, 3 per cent.
Sharpest curve, radius of 861 ft.

ELEVATIONS: East portal, 130 ft.
Laguna Honda Station, 372 ft. at 72 ft. below grou surface.
West portal,, 342 ft.
Elevation of ridge penetrated: North Peak 9 ft., South Peak 910.97 ft.
3½ minutes to pass through tunnel at 40 miles pe hour.

TIME: Working schedule not to exceed 6 minutes.
From Second and Market Streets to East Portal, minutes.
From Second and Market Streets to Sloat Boulevar 24 minutes.
Present schedule, 44 minutes.
Saving in time through tunnel, 20 minutes.



Laguna Honda Station in Tunnel.

COST ESTIMATE:

Lands	$ 600,000	Paid for by Twin Peaks
Tunnel const...	3,400,000	Tunnel Assessment Dist.
Tracks	250,000	Paid for by City.
Total	$4,250,000	

CONSTRUCTION WORK:
Reinforced concrete lined throughout.
Electric power used on all construction work.
Concrete mixed and transported 3,900 ft by ... pressed air.

CONTRACT:
Awarded November 2, 1914.
Signed, November 2, 1914.
Work started, November 30, 1914.
Work completed, July 14, 1917.
Time allowed to complete, 1,000 days.
Time required to complete, 985 days.

ENGINEERING:
Line met by one-eighth of an inch.
Levels checked by three-eights of an inch.

QUANTITIES:

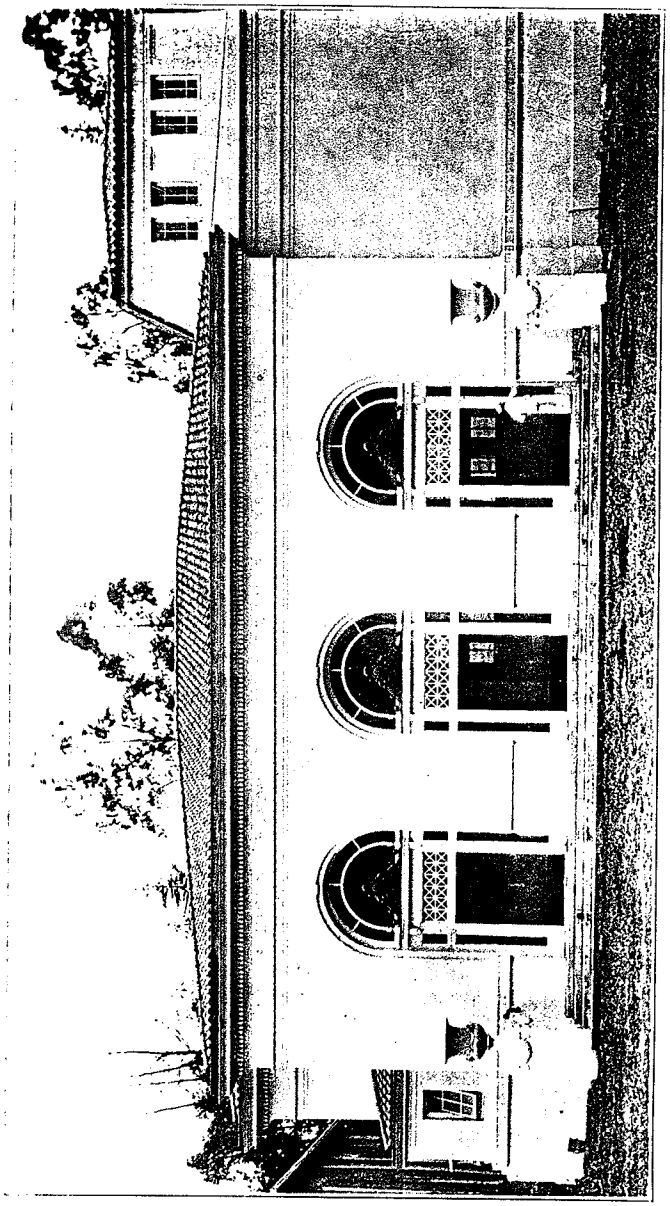
Excavation	530,000 cu. yds.
Cement	120,323 bbls.
Sand	39,458 cu. yds.
Gravel	94,245 cu. yds.
Reinforcing steel	2,850 tons
Timber	11,000 M ft.

GEOLOGY:
Open cut and west tunnel section, 5,000 ft. in sa... of which 1,000 ft. was saturated.
Open cut east end, dry sandy clay, 2,300 ft.
Tunnel.—Chert, sandstone, and 3,500 ft. serpentin...

SUBWAY STATIONS:
(1) Eureka Valley Station, in the vicinity of Se... enteenth and Castro Streets, the easterly porti... is a structural steel frame encased in concre... 300 feet long by 51 feet wide, connecting wi... the street surface.

(2) Laguna Honda Station is an expanded porti... of the tunnel, 300 ft. long by 41 ft. wide, with ... ft. clearance above rails in center. Tricentric ar... lining 3 ft. thick, with heavy concrete invert.

VENTILATING STATIONS:
Eighteenth and Hattie Streets and at the Relief Home tract.
Relief Home Tract ventilating shaft connected wit... tunnel by a reinforced concrete lined shaft 13 ft. in diameter and 110 ft. high.



Laguna Honda Surface Station.

VENTILATING DUCT: Ventilating duct in tunnel is between a suspended reinforced ceiling slab at the spring line and the intrados of the arch. The air passes from the duct into the tunnel through louvres in the ceiling slab spaced at 50 ft. intervals.

CONTRACTOR: R. C. Storrie and R. B. Muir.

ENGINEER: M. M. O'Shaughnessy, M. Am. Soc. C. E.

SEWER SYSTEM

The construction program for main sewer extensions as outlined in the last annual report was strictly adhered to resulting in the construction of the following mains:

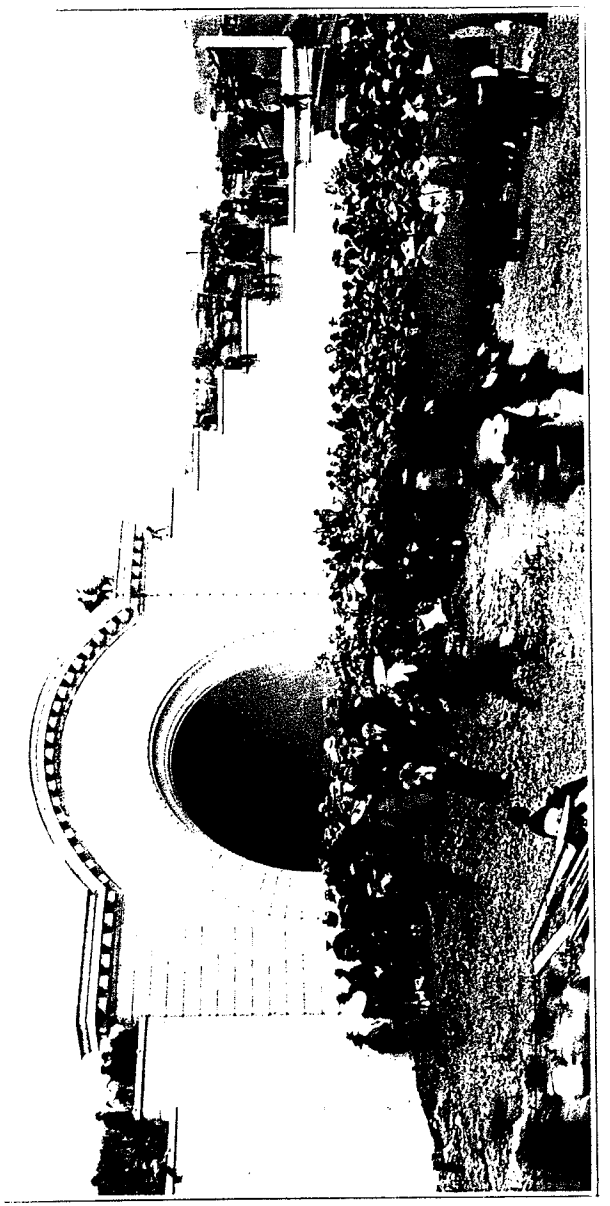
Orizaba and Stanley Streets sewers, providing for an outlet for the west side of the Ocean View District, extending northerly along Orizaba Street from Palmetto Avenue to Stanley Street; thence westerly along Stanley Street to the Spring Valley Water Company's property; thence northerly to join the existing sewer west of the Ingleside Terrace.

La Playa and Great Highway sewer from Noriega Street to Lincoln Way where connection was made to the existing 9'x11' main in 48th Avenue and Golden Gate Park.

Felton Street and Somerset Street sewer in Felton Street from University to Somerset and in Somerset from Felton to Wayland.

Glen Park sewer extension of existing sewer from Burnside Street to a point 500 feet westerly therefrom.

The Stanley Street sewer was constructed by D. L. Bliefeld for $29,088.97. That portion which lies in the Spring Valley Water Company's property consists of 16" and 18" cast iron pipe. Where the line crosses a deep gulch the sewer is supported on a wooden trestle 330 feet long whose highest bent is 43 feet. The grade summit in Ocean View directs the drainage easterly and westerly, the former eventually reaches the outlet at the foot of Sansome Street via the North Point Main and the latter enters the Ocean at the North end of 48th Avenue produced after traversing the Mile Rock Tunnel under the Sutro Heights.



South Portal—Twin Peaks Tunnel on Day of Dedication.

ANNUAL REPORT

OF THE

Bureau of Engineering

OF THE

Board of Public Works

City and County of San Francisco

FOR THE

Fiscal Year ending June 30, 1918

M. M. O'SHAUGHNESSY
City Engineer

THE GENERAL PRINTING CO.

PRESS OF THE NEAL PUBLISHING CO., SAN FRANCISCO

MUNICIPAL RAILWAYS

Present Status of Street Railway systems in San Francisco

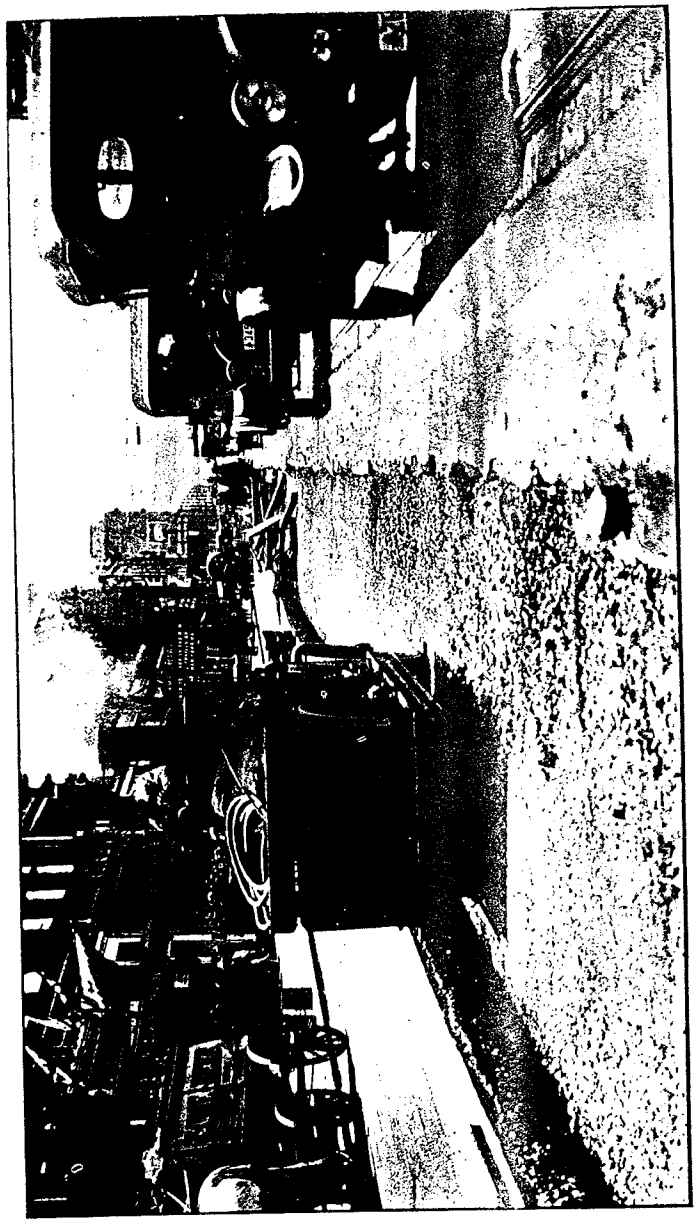
Street Railway transportation in San Francisco is handled by three separate systems, each under separate management and control. The combined total single track mileage of the three systems operating in the corporate limits of the City is 326.6, of which 301.5 miles are electric trolley operated and 25.1 miles are cable operated lines. Originally the mileage of cable operated lines was much greater but following the fire and earthquake of 1906 many of the cable lines were reconstructed as electric lines, the use of the cable only being adhered to where the steepness of the grades prohibited the adoption of the cheaper method of operation.

California Street Cable Railroad System:

The California Street Cable Railroad Company is the smallest of the three systems. It operates three lines all of which are cable propelled, the California Street line 2.86 miles, the Hyde and O'Farrell line 2.10 miles and the Jones Street lines .32 miles, a total of 5.28 miles of double track or the equivalent of 10.56 miles of single track.

The Company operates a total of 38 cars, 19 on the California Street line, 17 on the Hyde and O'Farrell, and and 2 on the Jones Street line. These cars are approximately 35 feet in length weigh in the neighborhood of 11,500 pounds and have a seating capacity of 34 passengers; they are open at both ends with a closed center section and are designed for operation in either direction using one grip.

The track is 3' 6" gage, with 3½", 55-lb. grooved rails laid as in cable construction in steel yokes. The track and roadbed is well constructed and is maintained in excellent condition. The maximum grade is 21.3 per cent on Hyde Street, between Francisco and Bay Streets.



Compacting roadbed for Four Tracks on Market Street

BOULEVARDS AND STREETS

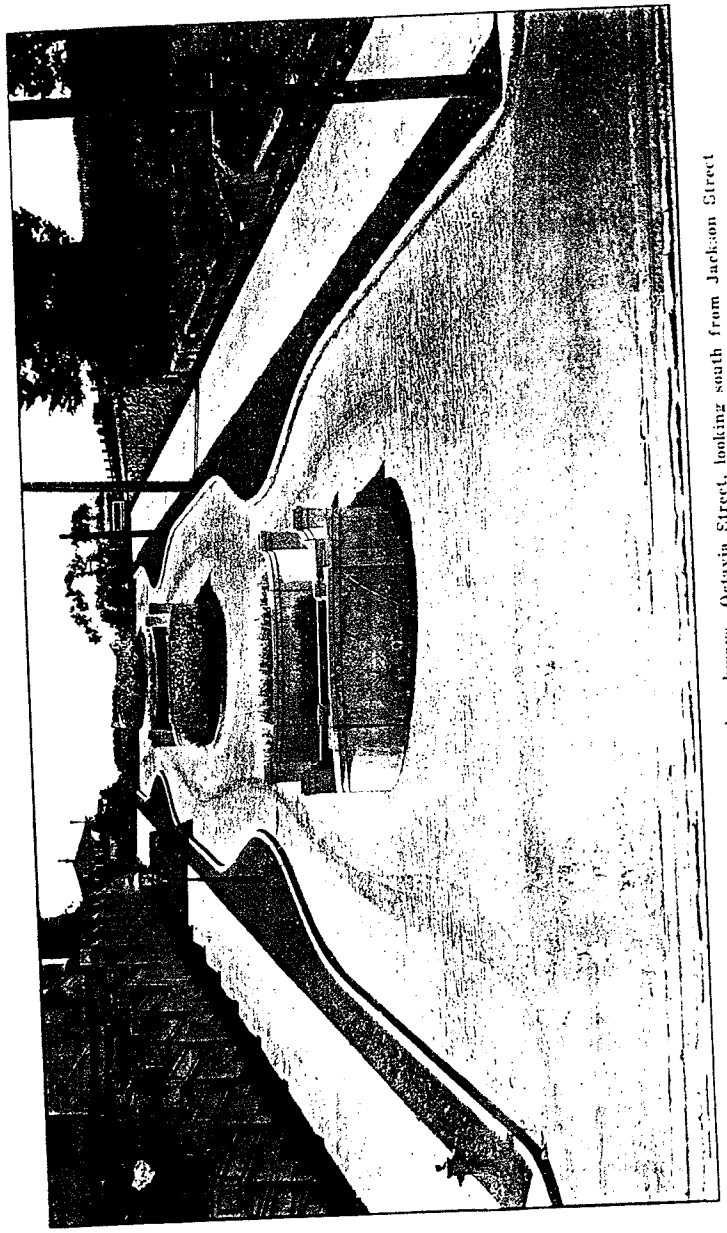
Actuated by a spirit of conservation and to conform to the policy of the Federal authorities, the construction of additional portions of the boulevard system with the exception of very essential units, has been postponed until after the war.

The Bernal Cut, Esplanade and Olympus Boulevard, all of which will be incorporated into the general boulevard system, were not deemed to be absolutely essential to the immediate needs of San Francisco, although it is of great importance to the commercial development of the City that their construction be undertaken as soon as feasible.

However, a thoroughfare which was deemed essential to war industries, not only by the City authorities, but also by Government officials, was the Hunter's Point Boulevard. This roadway affords an excellent avenue for transportation from the Bay Shore Boulevard to the Hunter's Point Dry Dock. The boulevard is almost two miles long and eighty feet in width.

The work was performed under five contracts by H. Crummey, Inc. Section A was located on Evans Ave., from Lane to Ingalls Street; Section B from Evans and Ingalls to Hawes and Hudson to Innes and Hawes; Section C from Hawes and Hudson to Innes and Donahue; Section E on Donahue Street from Innes to Galvez Avenue, and on Galvez Avenue from Donahue to Coleman, and Section F from Galvez and Coleman to Fairfax and Boalt, over a private right of way.

To finance this essential improvement, the City Engineer secured the co-operation of the Bethlehem Steel Company, which contributed the cost of constructing Section B; owners of adjacent property donated the rights of way where these were not already owned by the City. The cost of Section F was defrayed by the City, and the funds necessary to complete all the contracts



Special treatment, brick pavement and parkways Octavia Street, looking south from Jackson Street

except Sections B and F were raised by assessments against the properties fronting on the Boulevard.

Excavation was performed by three steam shovels, most of the material being red rock with serpentine and the balance hard clay. It was necessary to blast the subsoil for practically the entire distance of the roadway. Motor trucks conveyed the surplus material to an adjacent fill or wasted it beyond the limits of the Boulevard. Where the roadway was constructed on fill, this was placed in successive layers one foot in thickness, wet and rolled by a ten-ton road roller.

The maximum fill 20 ft. in depth and containing 6500 cu. yds. was made on Section C. It was deemed advisable to allow this fill to settle completely before the pavement or curb was laid thereon. A temporary strip of the roadway was paved with macadam to meet immediate needs.

For the entire boulevard the excavation amounted to 67,656 cu. yds. and the fill to 48,436 cu. yds.

The pavement on Sections A, D and E consisted of a 6-in. concrete base with a 2-in. sheet asphalt cover. On Sections B and F, it consisted of a 6-in. concrete base with a 2-in. Topeka cover. In all 355,893 sq. ft of standard asphalt pavement, and 125,352 sq. ft. of Topeka were laid.

California granite curbs were set for the total length of the boulevard, and artificial stone sidewalks placed at each intersection, except as above noted and in sections B and F, where a six-foot sidewalk was placed for the entire length of those contracts.

The maximum grade of the boulevard is 9½%, and in Section B on a 400 ft. radius curve the outer curb and portion of pavement have a superelevation of one foot, which feature, together with the Topeka top, will remove all danger of skidding at any normal speed.

Marina Boulevard:

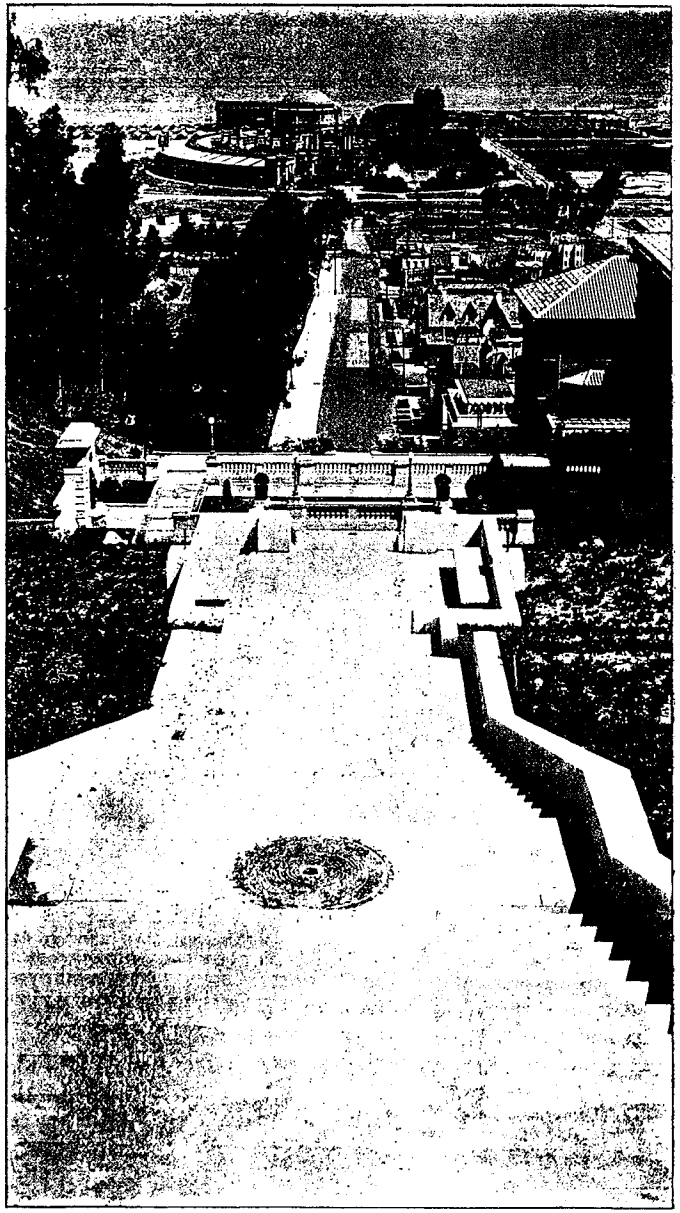
Another avenue that was considered important from a military standpoint was the Marina Boulevard, 100 feet wide, which extends from Fort Mason to the Presidio. Accordingly over the fill placed last year from Laguna to Scott Streets, Topeka pavements were laid during the past fiscal year and concrete curbs placed. This work entailed the removal of 3500 yds. of earth, the construction of sewers and appurtenances, 113,000 sq. ft of pavement, 8000 sq. ft. of brick gutters, 4000 lin. ft. of concrete curb and 34,000 sq. ft. of artificial stone sidewalks. The entire cost was $35,838.54.

Lands held in private ownership and necessary for this improvement, were deeded to the City by the Pacific Gas & Electric Company in consideration of a spur track from the Belt Railroad into the property of that corporation being constructed by the State Harbor Commission at the City's expense.

Widening of Sloat Boulevard—Sloat Boulevard Circle:

During the past twelve months the United Railroads Company has moved its tracks from the northerly line of Sloat Boulevard to the center of the proposed new 135-foot thoroughfare. This improved boulevard will consist of a central strip, 35 ft. in width, for the United Railroad tracks, on both sides of which will be two 30-ft. paved strips, outside of which will lie 5 ft. parking strips, and finally on both sides will be 15-ft. sidewalks. Only that portion of the Boulevard between 19th Avenue and Juniperro Serra Boulevard is to be paved immediately.

Sloat Boulevard Circle on which work will be started shortly, will separate from vehicle traffic the heavy network of tracks at the junction of the Twin Peaks Tunnel Line and the United Railroad's Sloat Boulevard Line. This improvement will be included in the same contract with the widening of Sloat Boulevard. The estimated cost of the improvement exclusive of parking, which will be paid for by interested property owners, will amount to $25,000.00.



Lyon Street Improvement

Market Street Extension:

Originally it was intended to construct the Market Street Extension from 17th and Castro Streets to the intersection of 24th Street with Corbett Avenue, the intention being to levy assessments on the district benefited to pay for the improvement.

Until normal conditions again exist, work will be undertaken only on the stretch from Falcon and Caselli Ave. to the southerly terminus of this improvement at 24th Street. The completion of this unit will provide a route for vehicular traffic over the Twin Peaks Ridge, starting at 17th and Castro Streets and extending over 17th Street to Corbett Ave., thence to Caselli Avenue, thence over over the new section contemplated and connecting on the south with Portola Drive.

The length of the section to be built at this time is 3400 ft., and the maximum grade is 8 per cent. The width of the boulevard will be 70 ft. with a 46-ft. roadway and terraced parking strips on either side thereof. The estimated cost is $160,000, of which $54,000 will be expended for the acquisition of rights of way, and $106,000 for actual construction. Property owners are to pay a maximum of $10 for construction costs a front foot, which will aggregate $70,000 toward this improvement. The City will bear the expense of the remaining $90,000.

Worcester Avenue Boulevard:

Economy demands early attention to a shorter route to connect Mission Road with the Junipero Serra Boulevard in the vicinity of the county line. The route selected begins at the intersection of Mission Street with Sickles Avenue; thence along Sickles Avenue to Plymouth Avenue, to Sadowa Street, to Orizaba Avenue, to Stanley Street, thence along Worcester Avenue to the Junipero Serra Boulevard. This route is paved as far as Orizaba Avenue. On account of the low assessed valuation of the property fronting Worcester Avenue, it will be necessary to pay for a portion of this boulevard out of

View of San Francisco from Twin Peaks Boulevard

the Good Roads Fund. Probably $20,000 will be appropriated for this purpose.

Great Highway:

It is essential that the Great Highway from the Cliff House to Sloat Boulevard be widened and suitably paved. This thoroughfare would be of military use as it connects Fort Miley with Fort Funston in the Merced Rancho, and is an essential link in the boulevard system. The Federal Government, however, did not believe the improvement of sufficient military value to warrant the expenditure during war times. It is hoped that the improvement will be undertaken immediately after the cessation of hostilities.

San Jose Avenue Widening:

The congestion of motor vehicles on Mission Road will be obviated by the improvement of the parallel boulevard along San Jose Avenue. Studies are being made for the widening of this thoroughfare and the pavement of its southerly course.

The following is a report on the official grades changed and established in the City and County of San Francisco during the fiscal year ending June 30, 1918:

Grade changes (379 blocks) (148 crossings)	26.10 miles
Grade establishments (24 blocks) (8 crossings)	1.90 miles
Investigations (245 blocks) (157 crossings)	21.30 miles
Total	49.30 miles

Many of the districts in San Francisco were platted without regard for the contour of the ground. A right angle system of streets seemed to be the only plan followed by the surveyors who laid out our City, some grades being as steep as 50 per cent.

Many good improvements were built on these steep hillsides before the streets were improved, the builders

having no idea, nor making any inquiries where the street grade might be.

After a number of homes were built haphazardly on one of these steep hillsides, it became necessary to construct sewers for sanitary reasons. Grades had then to be established to conform, as closely as possible, to existing improvements.

The accompanying photographs show some special grade treatments provided in such cases:

BUREAU OF ENGINEERING
AMOUNT AND COST OF STREET WORK—PUBLIC
Fiscal Year Ending June 30, 1918

Asphalt (6" Base)			
W. S. 2"	228,489.06	sq. yds.	$ 412,180.33
W. S. 1½" Binder 2"	2,282.60		4,827.78
W. S. 2½"	2,648.57		5,005.81
Basalt Blocks			
Gravel & Asphalt Filler	4,718.76		16,987.60
Cement Filler	2,386.92		9,585.54
Gravel Filler	4,122.66		14,773.77
Vitrified Brick			
Hillside	802.77		2,528.75
Asphalt with Basalt Strip			
W. S. 2"	1,633.40		3,908.13
W. S. 2½"	1,737.55		3,284.40
B. B. Gravel Filler	932.16		3,581.06
Asphalt with Vitrified Strip			
W. S. 2"	43,928.67		80,471.47
Hillside Brick	13,499.16		45,874.26
Broken Rock	1,666.66		450.00
Cobbles	173.01		513.86
Curbs			
Granite—new	23,159.17	lin. ft.	23,131.17
Granite—reset	1,038.07		409.86
Granite—redressed	198.90		3 98
Concrete	97,527.62		67,643.53
Gutters			
Bas. Blocks	938.72	sq. yds.	3,758.61
Art Stone Walks	37,441.71		41,499.05
Grading			
Cut			121,857.67
Fill			21,702.44
Forward			$883,979.67

BUREAU OF ENGINERING

AMOUNT & COST OF STREET WORK CONTINUED—PUBLIC

	Number	Lin. ft.	Cost
Brought forward			$883,979.67
I. S. P. 6"		2,671.90	3,847.50
I. S. P. 8"		15,779.16	23,478.12
8" Y's	684		745.24
I. S. P. 12"		7,116.89	19,963.14
12" Y's	338		510.07
I. S. P. 15"		2,317.77	3,115.77
15" Y's	46		106.96
I. S. P. 18"		2,235.33	6,588.82
18" Y's	108		237.54
I. S. P. 21"		1,434.00	4,452.60
21" Y's	75		171.75
I. S. P. 10"		8,712.78	10,287.65
Manholes			
New	133		10,175.50
Rebuilt	1		25.00
Catchbasins			
New	316		23,004.50
Reset	10		375.00
Stairs (7)			1,005.00
Pipe Railings		707.00	2,646.98
Coping		134.02	330.02
Concrete Sewer		34.00	255.00
Traps	50		150.00
Concrete Walls		181.00	3,500.00
Retaining Walls, etc.			11,112.00
Construction a/c			21,000.00
Total			$1,031,063.83

ANNUAL REPORT

OF THE

Bureau of Engineering

OF THE

Department of Public Works

CITY AND COUNTY OF SAN FRANCISCO

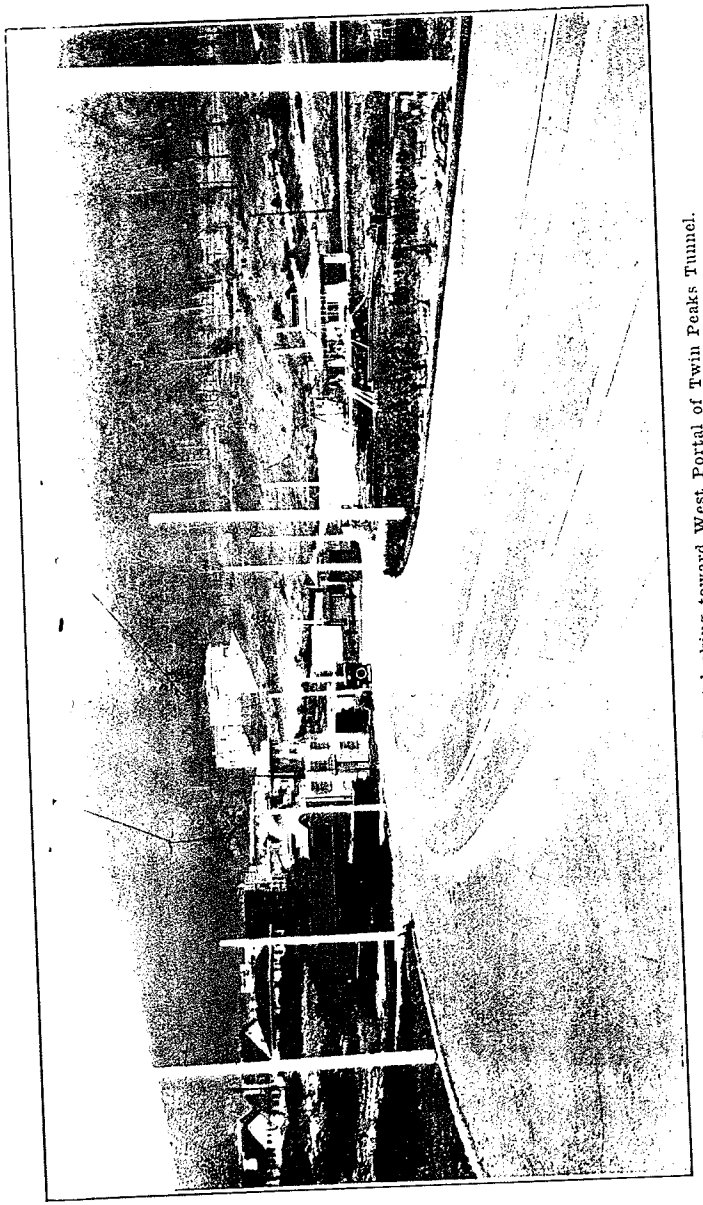
Fiscal Year ending June 30, 1919

M. M. O'SHAUGHNESSY
CITY ENGINEER

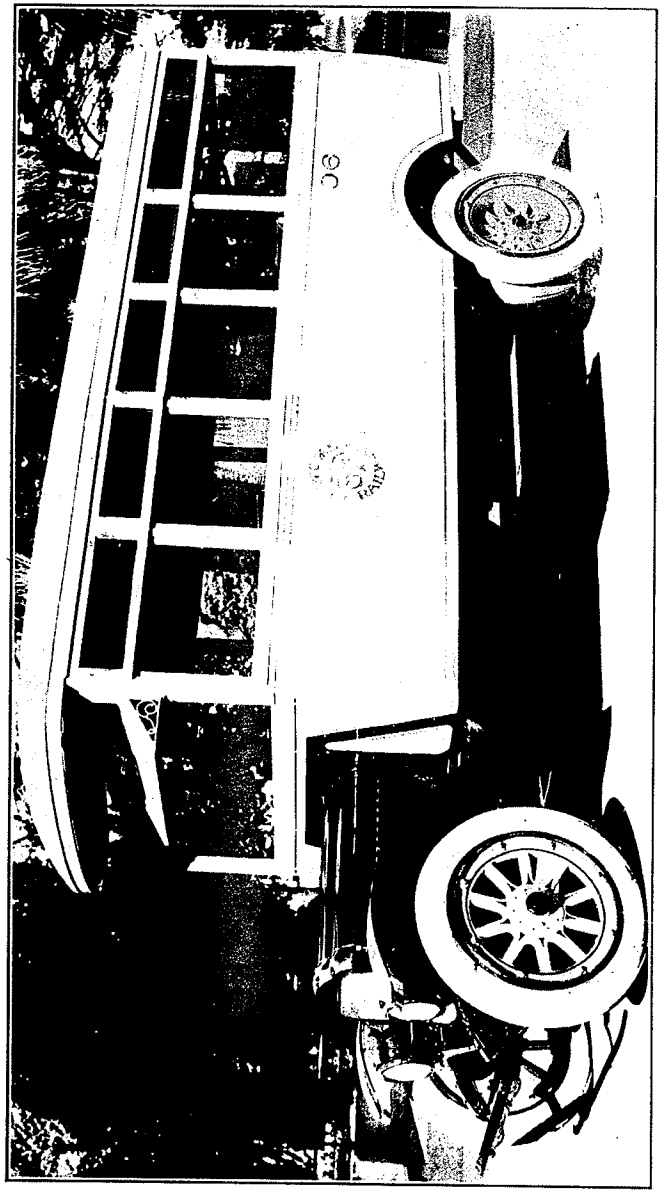
PRESS OF NEAL PUBLISHING COMPANY, SAN FRANCISCO

of line and connected at the United Railroads end with track special work installed by that company.

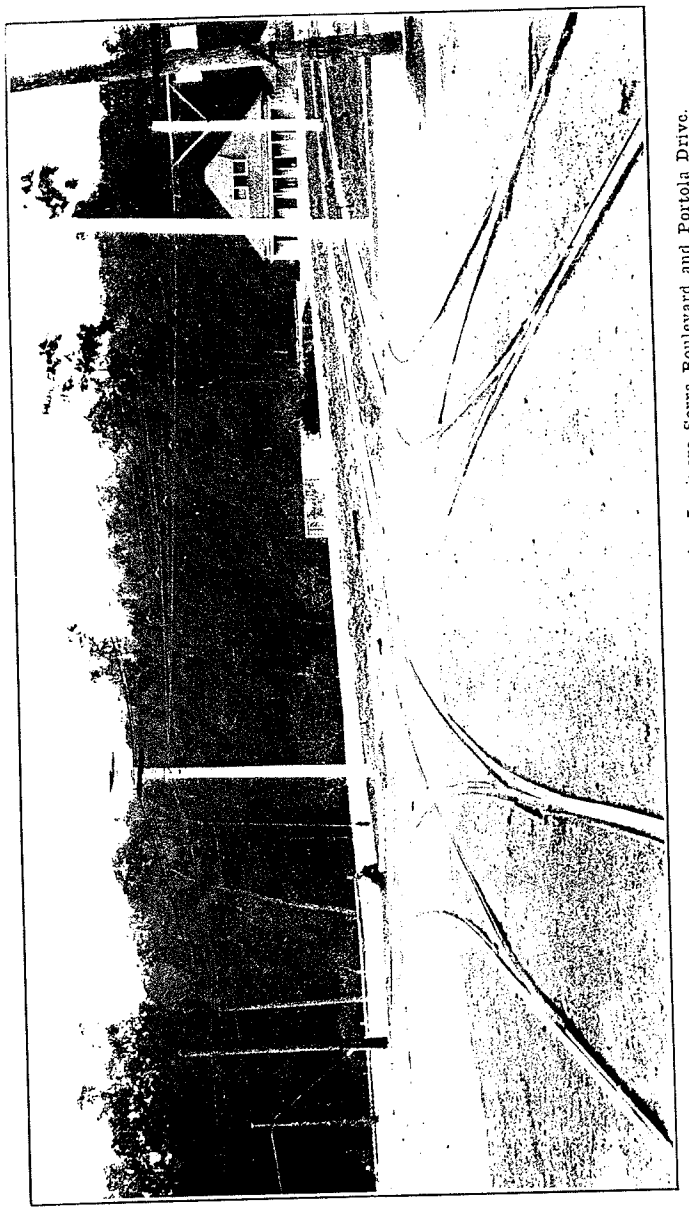
Due to copper declining in price and again commencing to rise, it was deemed best to buy some trolley wire for maintenance purposes. At the request of the Superintendent of Municipal Railways, Specifications No. 1394 were prepared covering three miles of 3/0 round copper trolley wire, which was purchased June 18, 1919, from the



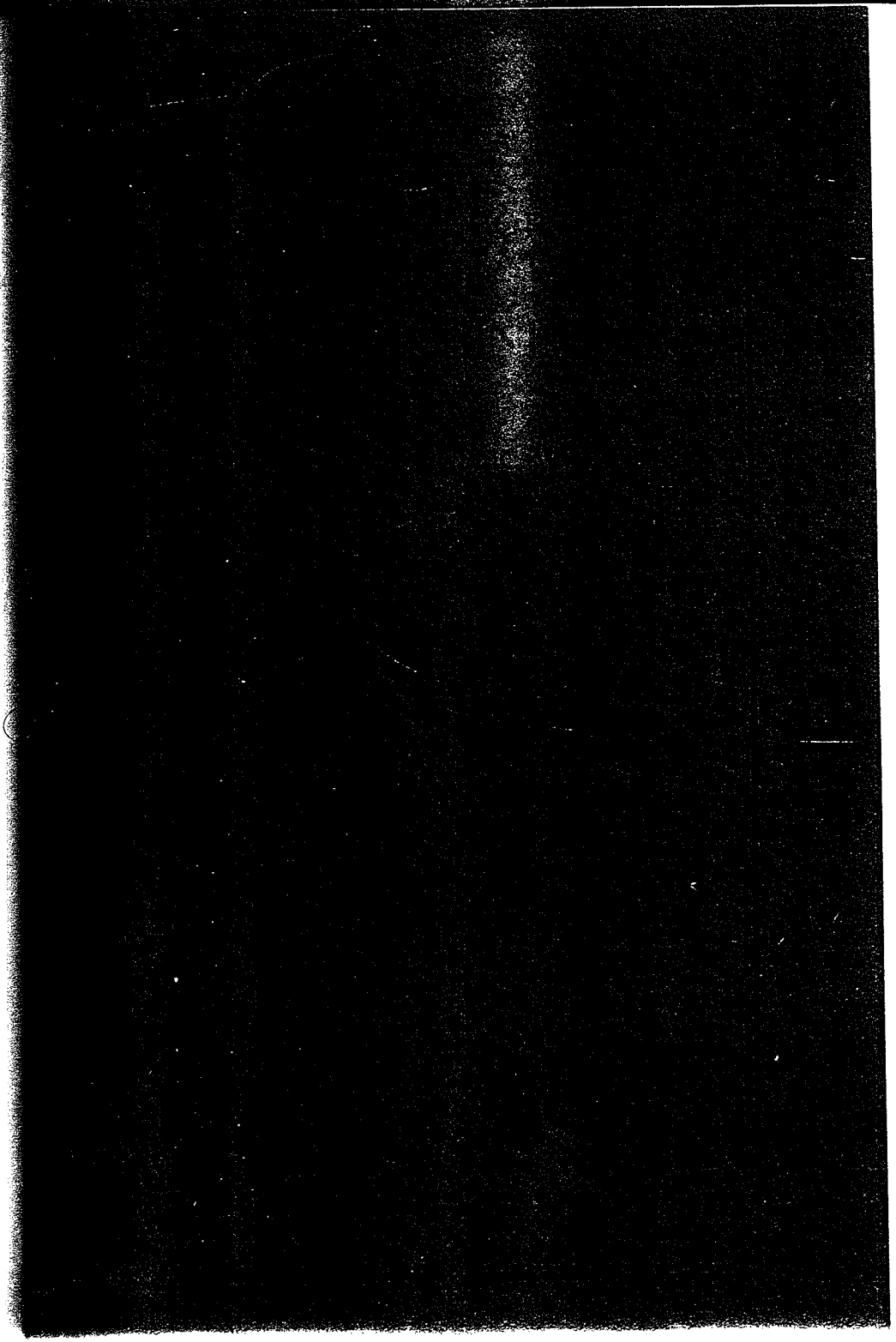
Municipal Railway on Ulloa Street looking toward West Portal of Twin Peaks Tunnel.



Municipal Railway Auto bus of latest type



Junction of Municipal Railway and United Railroads tracks, Junipero Serra Boulevard and Portola Drive.



1923

undertaken. The increase in receipts of 20 cents per car hour throughout the year has been largely due to the superior service offered the public by the Municipal lines.

Paving:

The amount of street paving accomplished has shown a marked increase, asphaltic concrete wearing surface with a paint coat on a concrete base having the greatest yardage. Concrete pavements were also introduced and may solve the problem of our hillside pavements.

For further detailed information regarding the different features I beg to refer you to the subsequent detailed report.

Very respectfully,

M. M. O'SHAUGHNESSY,
City Engineer.

BOULEVARDS, STREETS AND HIGHWAYS.

The status of San Francisco's street and boulevard development is well summarized in this statement contained in the recent volume, "California Highways," by Ben Blow, manager of the Good Roads Bureau, California State Automobile Association:

"The City and County of San Francisco, small in area and thickly settled throughout, with many manufacturing and commercial enterprises, which supply an enormous burden of heavy hauling, naturally finds its main traffic problems involved in the construction and maintenance of city streets rather than of roads.

"These problems, it may be said, are being intelligently met and mastered, even the destruction caused by the fire and earthquake of 1906 scarcely seeming to interrupt progress; and compared with other big cities of the United States, San Francisco stands well up in its street development, having as well approximately 20 miles of purely scenic boulevards.

"In so far as its boulevard development is concerned, however, the citizens of San Francisco may well be pardoned if they express enthusiastic pride, for, in spite of the limited area of the city, there have been scenic boulevards developed which compare favorably with the most famous of the United States—the Twin Peaks drive perhaps ranking above all others in variety of interest. * * *"

The rapid increase of automobile utilization demanded the improvement of the city's thoroughfares and the addition of numerous paved avenues for motor vehicle traffic. This traffic in turned provided some of the necessary funds for boulevard construction. Under the provisions of the Motor Vehicle Act passed by the State Legislature May 31, 1913, provision is made for the registration and payment of license fees for motor cars, and also that all fees or other moneys paid to or collected by the State Treasurer under the provisions of this act shall be placed in the Motor Vehicle

Funds. One-half of the net receipts (the balance after expenses of administration and enforcement of this act are deducted) are returned to the counties from which received (as determined by the residence of license owners) and placed by each county in a County Road Fund, the moneys so received to be expended by said counties exclusively in the construction and maintenance of roads, bridges and culverts.

Since the establishment of this fund by the City and County of San Francisco the State has contributed from the funds collected under the Motor Vehicle Act the sum of $781,233.53 and the city has added to this $113,500.00.

At the beginning of the past fiscal year the City Engineer's department was reduced in size due to curtailment of the budget appropriation by the Board of Supervisors. However, an unusually large street repair program involving an expenditure of some $320,220 for the last fiscal year placed many duties on the working force of this department, as all street plans having to do with such reconstruction are now prepared by this department. In the list of streets for which reconstruction plans were prepared many difficult problems arose due to changes in street levels and the extremely high value of the adjacent property.

During the past fiscal year the following important units of the highway and boulevard system were developed: The Great Highway, Circular Avenue, Monterey Boulevard, Parker Avenue, portion of the Market Street Extension and Townsend Street.

Great Highway:

In the preparation of the plans for paving the Great Highway particular attention was given to the design of the crown grades and cross-section. South from Lincoln Way the old macadam pavement resting on a sand foundation was utilized in so far as possible as a base, since the years of travel that it had carried compacted it to such a degree as to make it suitable for a foundation. The crown was reduced considerably from ordinary practice so as to minimize the effect of skidding, and yet give good drainage. On this portion the asphaltic concrete top is 2 in. thick. Between Lincoln Way and the Esplanade a 1½ in. asphaltic concrete top is laid on a 6 in. concrete base. Between Fulton Street and the north end of the Esplanade a commodious parking area has been provided for motorists.

A contract for paving the easterly portion (45 ft. wide) of the Great Highway from the southerly line of Fulton Street to a point 438 feet northerly from the northerly line of Balboa Street, a total length of 1880 feet, was awarded on January 16, 1920, to the Fay Improvement Company and completed and accepted on May 26, 1920. For paving the easterly portion (43 ft. wide) of this highway from Fulton Street to Lincoln Way contract was awarded to the Raisch Improvement on May 21, 1920. This is still in course of construction.

Circular Avenue and Monterey Boulevard:

This pavement involved a very careful grade study, involving the intersections of San Jose Avenue, Joost Avenue, Diamond Street, Gorham Street and the right of way of the Southern Pacific. A suitable approach to the Bernal Cut, the city's future main level highway route, was involved. Contract for the asphaltic concrete pavement, concrete curbs, culverts and catch basins was awarded to the Fay Improvement Company on October 27, 1919, and completed February 20, 1920.

Parker Avenue, St. Rose's Avenue, McAllister Street:

The grading and paving of this street affords a short cut to Golden Gate Park from the district north of the old cemeteries and connects also with Geary Street, one of the main thoroughfares of the city. This contract involved the moving of 2,000 cu. yds. of earth and laying of 60,000 sq. ft. of asphaltic concrete pavement and 8,500 sq. ft. of brick. The work was accepted from the contractors, Blanchard, Crocker & Howell, on September 26, 1919.

Holly Park Circle:

The improvement of this street encircling Holly Park has made accessible one of the city's beauty spots as well as added to the aesthetic and commercial value of the surrounding district. This work was performed by Clark and Henery under public contract, the city as owner of the park, school and firehouse property fronting on the improvement paying about one-half of the cost. The contract was awarded February 7, 1919, completed and accepted August 20, 1919, and included 85,000 sq. ft. of 2 in. asphalt on 6 in. concrete base and 3900 feet of concrete curb.

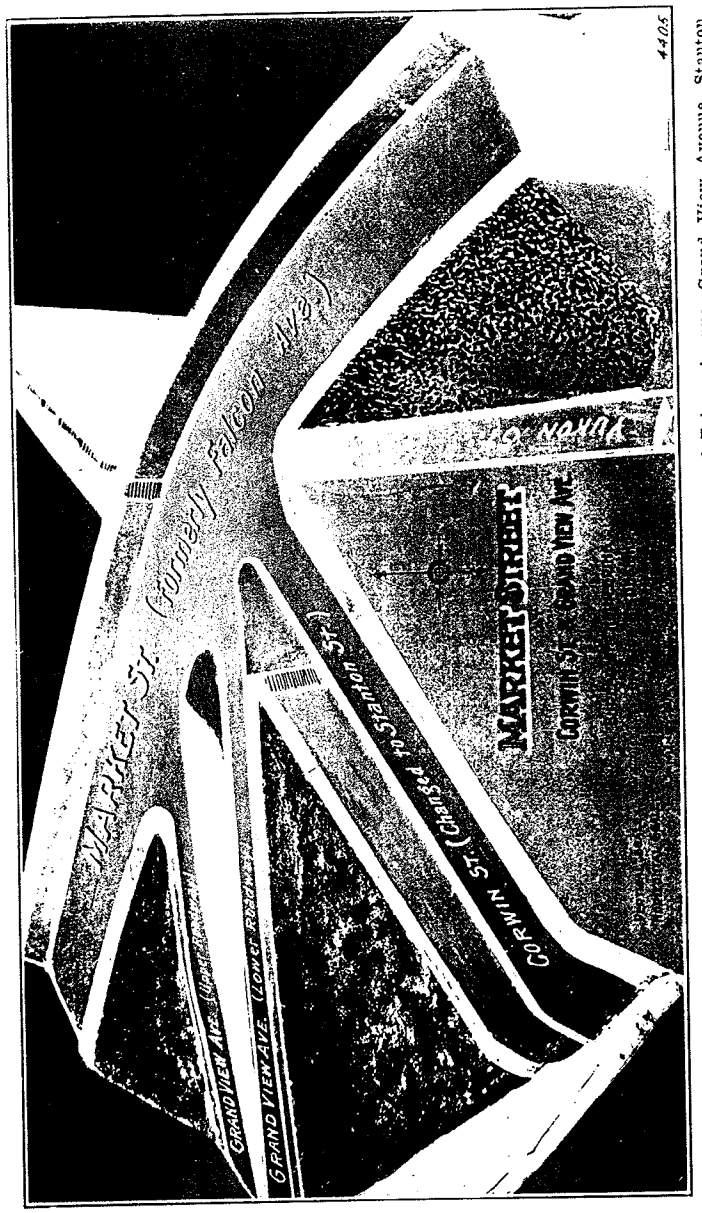
Sloat Boulevard, northerly strip from Great Highway to Fortieth Avenue produced.

This contract, awarded on June 4, 1920, to the Fay Improvement Company, is the second unit to provide for the paving of Sloat Boulevard to the full proposed width of 135 feet, another section having been completed in connection with the improvement of St. Francis Circle.

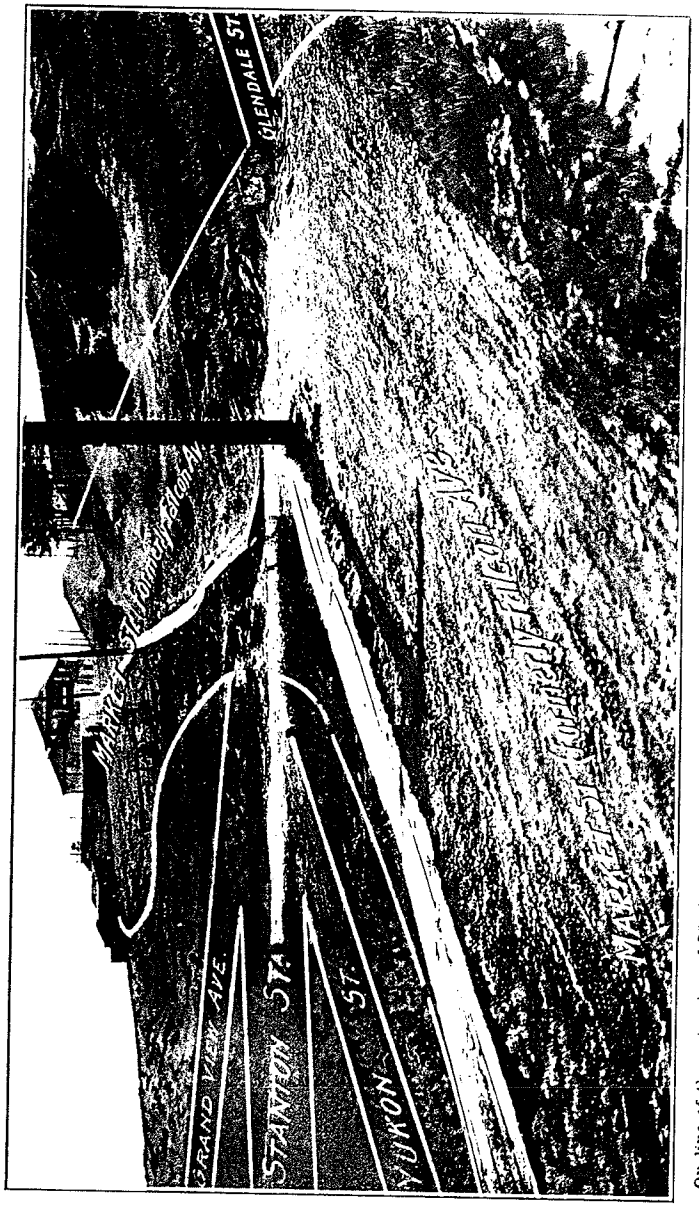
This contract provides a 30-foot paved strip just north of the 35-foot right of way of the United Railroads. A similar strip has already been paved on the south of the tracks, so there will be two 30-foot roadways with 35 feet for car tracks in the center and 20 feet on each edge for sidewalks and parking strips.

Market Street Extension, Collingwood Street to Ord Street with an extension to Eighteenth Street.

The work under this contract has been practically completed, but several details of minor importance yet remain to be done. This easterly section of the Market Street Extension and Corbett Road project lies over the double tube section of the Twin Peaks Tunnel and directly connects with the upper end of Market Street. A 90 foot right of way for this road was purchased by the city at the time of the construction of the tunnel and under this contract



Clay model. One of the methods used in making a study of the intersection of Falcon Avenue, Grand View Avenue, Stanton Street, Yukon Street and Glendale Street preliminary to the establishing of grades thereon.



On line of the extension of Market Street, showing existing conditions at the intersection of Falcon Avenue, Grand View Avenue, Stanton Street, Yukon Street and Glendale Street.

a 74 foot roadway has been paved, leaving 8-foot sidewalk space along each side. Approximately 85,000 square feet of 1½-in. asphaltic concrete surface on a 6-in. concrete base have been laid by the contractors, the Raisch Improvement Company.

Bids will soon be called for improving another section of the Market Street Extension which is the connecting link between Corbett Avenue and the central section of the city. The improvement of this boulevard from the easterly termination of Mono Street to Twenty-fourth Street will provide a completely paved highway from the Ferry Building to the beach, around the Twin Peaks, via Corbett Road, Portola Drive and Sloat Boulevard. There will remain to be improved the section of the Market Street Extension from Mono Street to Ord Street, but until all rights of way are procured and the work completed, a temporary but well paved route over Eighteenth Street and Falcon Avenue from Hattie Street to Caselli Avenue will connect up the completed sections of the drive.

PROPOSED WORK.

Great Highway Improvement:

Plans have been prepared and bids received for the paving of the westerly side of the Great Highway from Balboa Street to Cabrillo Street, which will complete the paving of the proposed roadway 150 feet wide between Cabrillo Street and the north end of the Esplanade. The work now being done under another contract will complete an 83-foot paved strip from Cabrillo Street to Lincoln Way—eventually this section will also be paved to the full width of 150 feet. Beyond Lincoln Way the upper roadway to Sloat Boulevard has a 30-foot strip paved and it is proposed also to improve and pave the lower road. Plans are now being prepared for widening and paving Point Lobos Avenue, the road skirting Sutro Heights and forming the connecting link between the

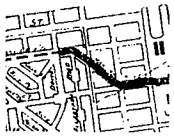
Great Highway and Geary Street. With the completion of this work San Francisco will possess a marine drive 3 miles in length of most up to date engineering and construction which will acquire the same world-wide fame attached to the Twin Peaks Drive and other local highways.

Sky Line Boulevard:

Under authority of an act passed by the State Legislature in 1917, the counties of San Francisco, San Mateo, Santa Clara and Santa Cruz joined together in forming a joint highway district for the purpose of constructing the proposed Sky Line Boulevard between San Francisco and Santa Cruz. The cost of construction is to be borne from the State Highway Bond issue of 1919. A reconnaissance survey has been made and rights of way are now being procured, the money for which must be raised by the highway district.

The general route of the project will start from Sloat Boulevard and follow the shore of Lake Merced, gradually ascending to meet the present Half Moon Bay Road about a mile west of Colma, thence proceeding along by the Spring Valley Lakes to the summit of the San Mateo-Half Moon Bay Road, thence following the divide to the summit and farther south connecting with the Saratoga-Big Basin Road. From this point the boulevard can follow the main crest of the mountains to the summit, connect with the Los Gatos-Santa Cruz State Highway over which it can proceed to Santa Cruz and Watsonville, or proceed over the State Park Road and Empire Grade to Santa Cruz, thence to Watsonville.

A boulevard over this route (115 miles in length from San Francisco to Watsonville) would appropriately be named the "Sky Line Boulevard," for it would follow the sky line along the crest of the ridge from Lake Merced to Santa Cruz Mountains. Rising from sea level to an elevation of 2800 feet, it will be the most interesting scenic route of the State, with



views of the Pacific Ocean, San Francisco Bay, Santa Clara Valley and Monterey Bay.

There is urgent need of another route down the Peninsula to relieve the constant and increasing traffic congestion along the State Highway. The Sky Line Boulevard would serve in this respect and would also make accessible a splendid region for residential development.

Report of the
Bureau of Engineering

1921 and 1922

Department of Public Works
City and County of
San Francisco

M. M. O'SHAUGHNESSY,
City Engineer

purchase of the Market Street Railway on a basis that will be fair to the citizens and just to the Company.

Work on the Hetch Hetchy Project has proceeded with great activity in the past two years. It has been the only period when adequate funds have been available to prosecute construction. An unauthorized strike was called by tunnel workers in August 1920 which blocked all construction for a period of three months and seriously embarrassed progress on the project until the following February. Very nearly 1,800 men are now employed on the project. The main Hetch Hetchy Dam should be completed by January, 1923, the balance of the mountain tunnels should be completed by August, 1923. Priest forebay dam is over 50 per cent completed at the present time and should be finished inside of a year. The tunnel and penstock grade to Moccasin Creek power house are under way. Contracts for the water wheels and generators for the power house have been awarded and all parts of the mountain division should be completed in two years from date.

Work on the Bay Division, 22 miles long, from a point near Niles to Crystal Springs Reservoir, is under construction, consequent on an order of the State Railroad Commission of California. The Pulgas Tunnel, 9,000 feet long, is under construction, through the ridge about 2 miles west of Redwood City toward Crystal Springs. Rights of way have been obtained for the balance of the pressure pipe line, while at the same time an option was obtained to purchase the Spring Valley property at any time within 10 years for $38,000,000. This work should be done in 2½ years.

Details of the different projects under construction are given in full in the attached report.

M. M. O'SHAUGHNESSY,
City Engineer.

BOULEVARDS, STREETS AND HIGHWAYS

For years Mission Street was the only paved direct route from the heart of the City, connecting with the main peninsular highway of San Mateo County to the south. Due to the adjacent large business section, it soon became too congested to accommodate the increasing volume of rapid vehicular traffic. One of the first problems met by this office in its campaign for better streets was the development of main routes of travel paralleling Mission Street.

Junipero Serra Boulevard and San Bruno Avenue were the natural selections for two main additional highways. In 1913, Junipero Serra Boulevard, from Sloat Boulevard to the County Line, was paved for a width of 25 feet with asphalt, the City paying $52,000 from its funds for this improvement. A section of San Bruno Avenue was graded and paved, payment for which was made by the property owners; another section improved through the financial co-operation of the City and property owners, and other sections by City funds alone. These three principal traffic routes lead from different sections of the city, but, through the plan which has been evolved, the system of cross connecting thoroughfares gives ready access from these main routes to all parts of the City.

Boulevards such as the Twin Peaks drive, encircling the summits of the Twin Peaks, and the Great Highway, the beautiful Ocean Beach drive, are of value mainly to the pleasure seekers and their construction is fully justified by their great use by pleasure vehicles. The greater portion of the system, though, serves the economic need for well paved, direct and short connections on easy gradient between sections of the City, and over which the products and necessities may be moved. The values of these roads were well brought out during the World War, when the constant movement of large amounts of military and naval supplies and industrial

products by trucks was amply taken care of without congestion by San Francisco's highway system.

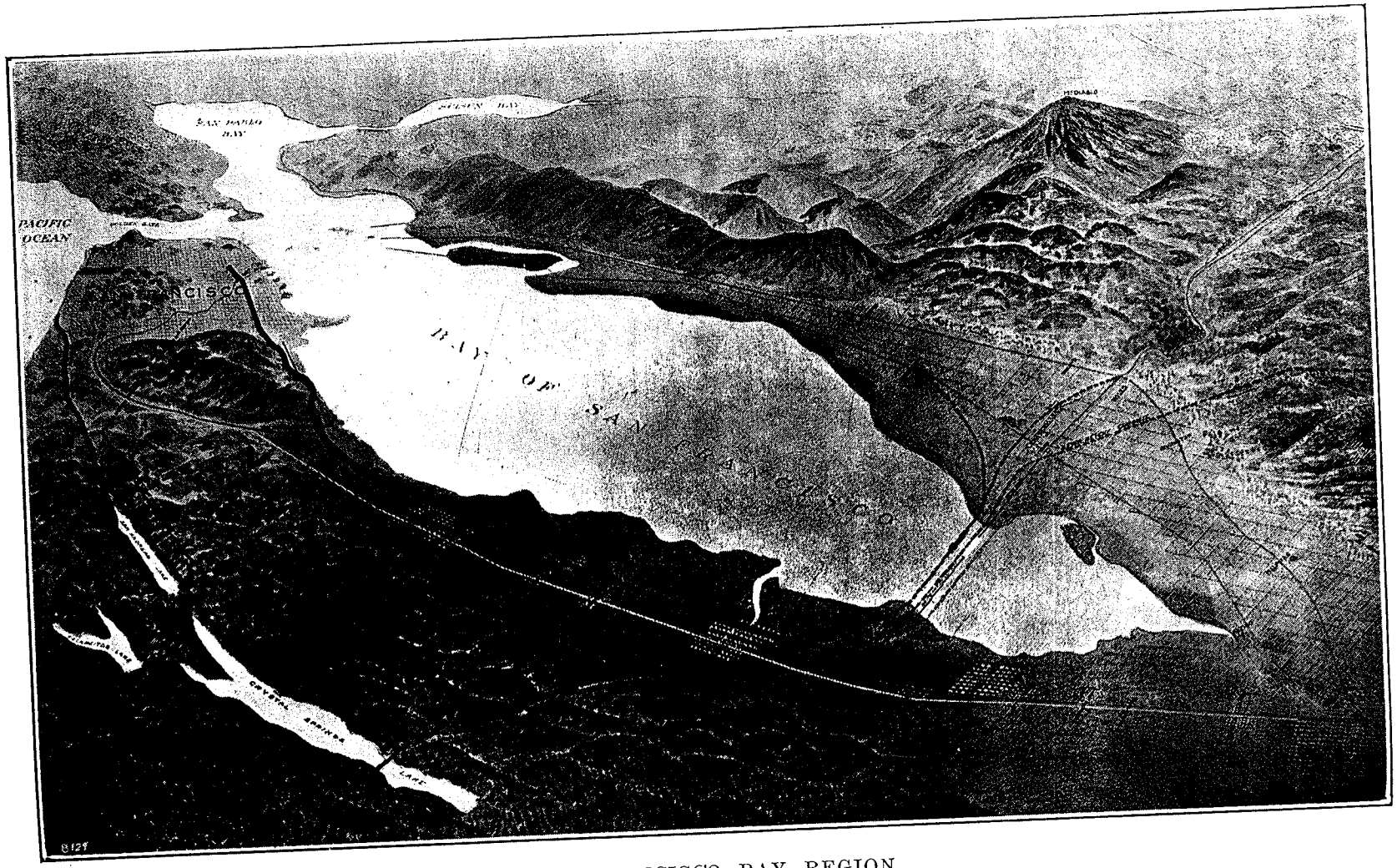
Auxiliary roadways, paralleling the main routes leading to the City's exits are now necessary and being developed. Howard Street and San Jose Avenue are two examples, both of which serve to relieve Mission Street of some of the traffic.

San Francisco's geographical location has proven a handicap in many respects, chief of which is its contracted physical connection with the surrounding territory and cities. Situated on the extreme end of a narrow peninsula, bounded by the Pacific Ocean and the San Francisco Bay on three sides, San Francisco has but one direction in which it can expand, and that is southward "down the Peninsula." Topographical features of the City have limited the location of the natural outlets in this direction.

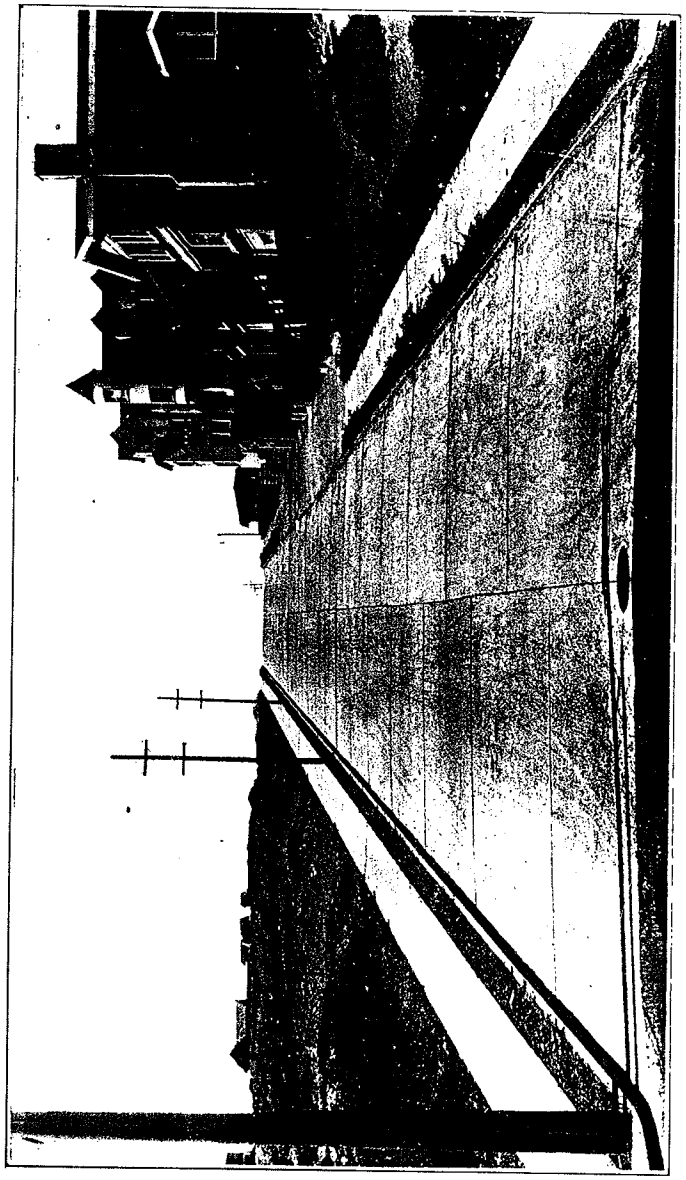
With the roadways through these exits completed or being developed, San Francisco has awakened to the fact that its main roadways lead into one highway outside its limits and that this present peninsular highway cannot carry the enormous traffic to and from this City. The problem of remedying this condition is not alone San Francisco's problem but is of vital interest to all the peninsular cities and counties. The Sky Line Boulevard, west of Lake Merced and through the Spring Valley lakes in San Mateo County, one unit of which is now under construction, will aid in relieving the congestion by diverting the pleasure vehicles over this scenic route. The proposed 125-foot highway along the bay shore now being studied by the engineers of San Francisco, San Mateo County and the State Highway Commission, offers another source of relief.

Types of Pavement Constructed:

The first pavement laid in San Francisco was the plank road to Mission Dolores, 2½ miles in length, completed in 1850. Other plank roads were constructed. Round cobble



SAN FRANCISCO BAY REGION
Showing Proposed DUMBARTON BRIDGE and PENINSULAR HIGHWAYS.

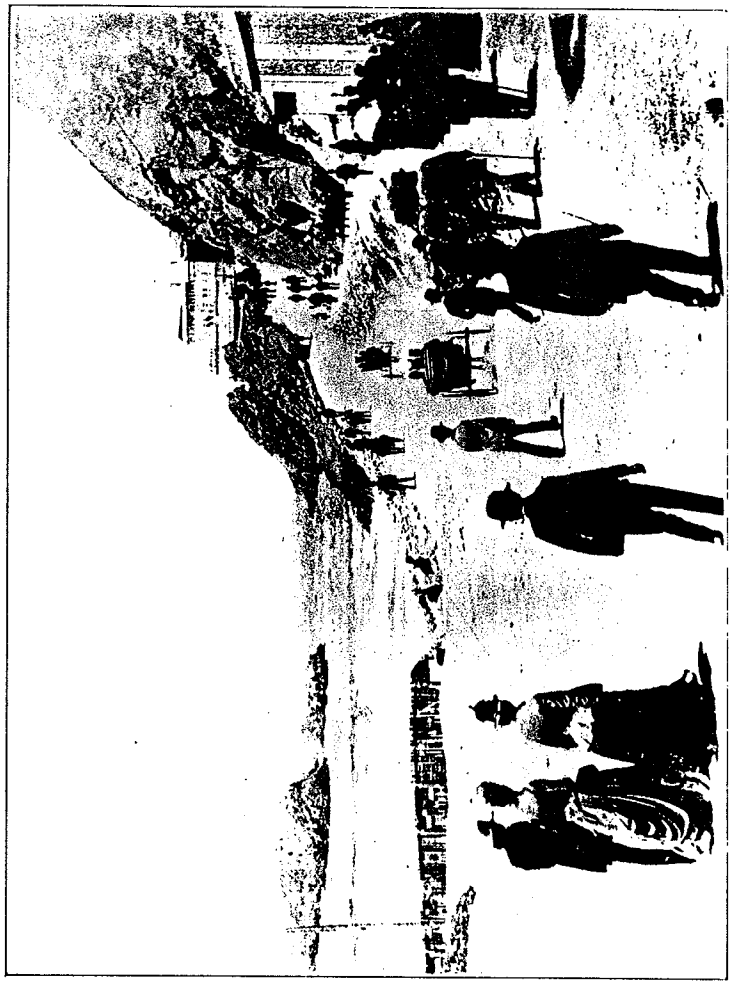


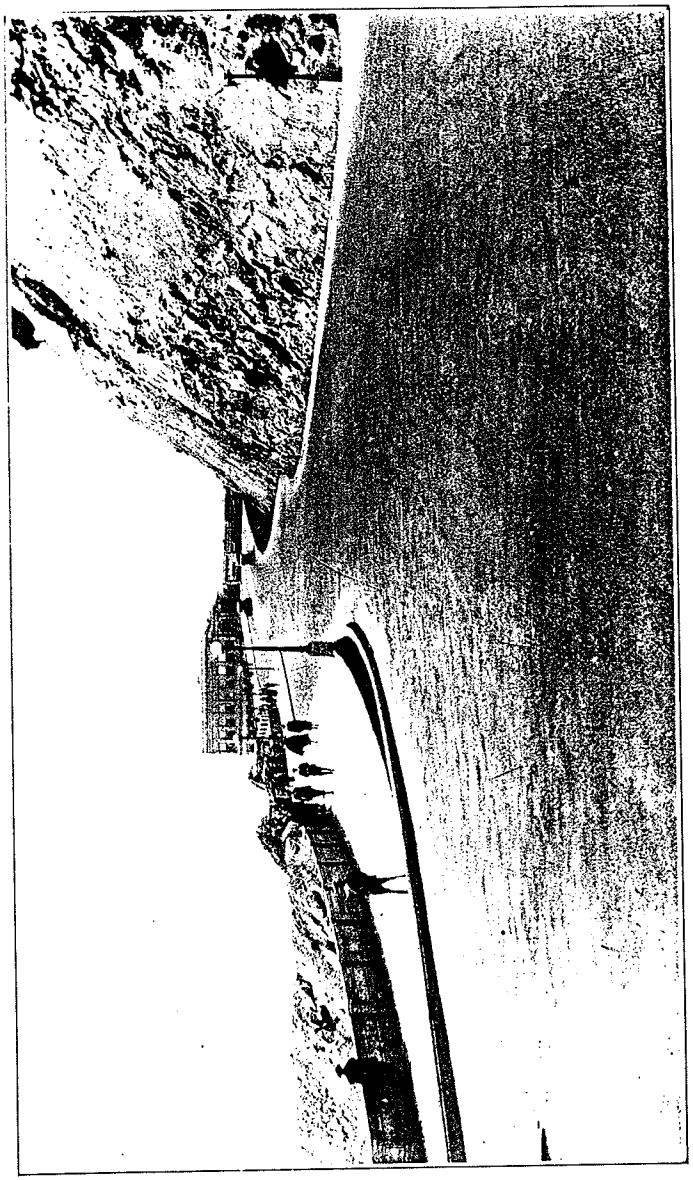
CONCRETE PAVEMENT

stones were utilized for paving the heavy traffic streets, also on steep grades. Later, basalt blocks were substituted for the planks and cobbles, except on the very steepest grades where the cobbles were allowed to remain, and in many instances still remain in these days. Basalt blocks have retained their usefulness as paving material on heavy traffic streets but are now laid on a concrete base. Bituminous rock and asphalt wearing surfaces on a concrete base replaced the other types of pavement, except on heavy traffic streets and upon the steeper grades. In the early days of bitumen or asphalt pavement, a thick wearing surface was thought necessary or a heavy intermediate binder course with a moderately thick wearing surface was used. While noiseless and resilient, the thick courses rolled under the heavy traffic and formed large waves in the surface. Today no bituminous rock pavements are being laid in this City, but an asphaltic concrete pavement, consisting of a 1½-inch asphaltic concrete wearing surface on a 6-inch concrete base, is used extensively. The asphaltic concrete is composed of asphalt cement between 8 and 11 per cent by weight, and mineral aggregate (sand, stone dust and broken stone) between 89 and 92 per cent. This makes an excellent noiseless and to a certain extent non-skid pavement.

Brick pavements have been constructed on many of our streets and have proven especially satisfactory for heavy traffic and for steep grades.

During the past few years several streets in San Francisco have been paved with concrete. Concrete pavements were an innovation in this City in 1919. Many types of pavement in use have concrete base but the first concrete pavement, consisting of a monolithic 6 inch concrete slab with no top course of any kind, in San Francisco, was laid on Winfield Street between Eugenia and Esmeralda Streets in that year. Since then over 400,000 square feet of concrete pavement have been constructed in this City.





POINT LOBOS AVENUE (CLIFF HOUSE ROAD) IN 1912

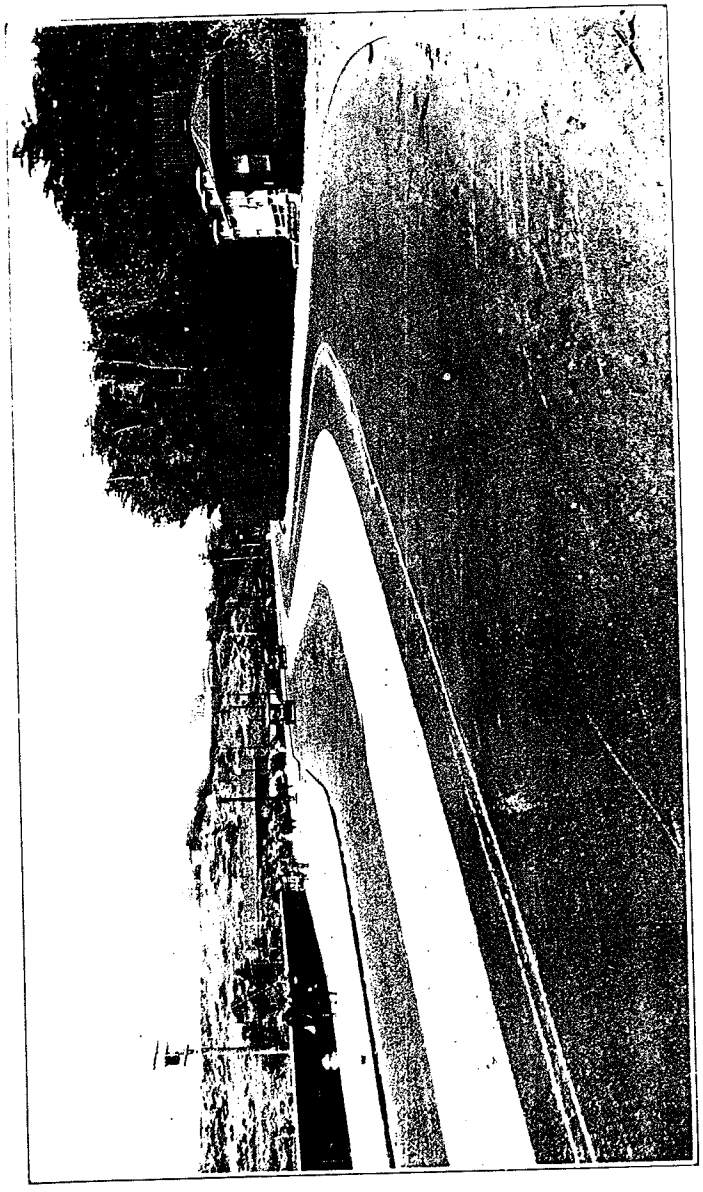
The following excerpt from the Ordinance which prescribed the use of concrete pavement, definitely sets forth where and how it may be used:—"Concrete pavement shall be limited in use to roadways of alleys, cul-de-sacs, and streets other than main traffic arteries and shall not be constructed on roadways with a greater width than twenty (20) feet, except where the gradient exceeds ten (10) per cent. The prerequisite to the use of concrete as a pavement shall be that the roadway by nature and by location relative to other streets, will not serve heavy or concentrated traffic."

For streets of narrow width and light traffic, concrete pavement provides a reasonably priced and good wearing pavement. Wide streets necessitate numerous unsightly expansion joints in concrete pavements and the joints are a source of failure in this type of pavement. Under heavy traffic, the concrete ravels at the joints and the corners of the slabs break off. For paving on grades, where traffic is light, concrete is more economical than brick. Elimination of the glare, due to the whiteness of the concrete, would tend to make concrete pavements more popular with the public.

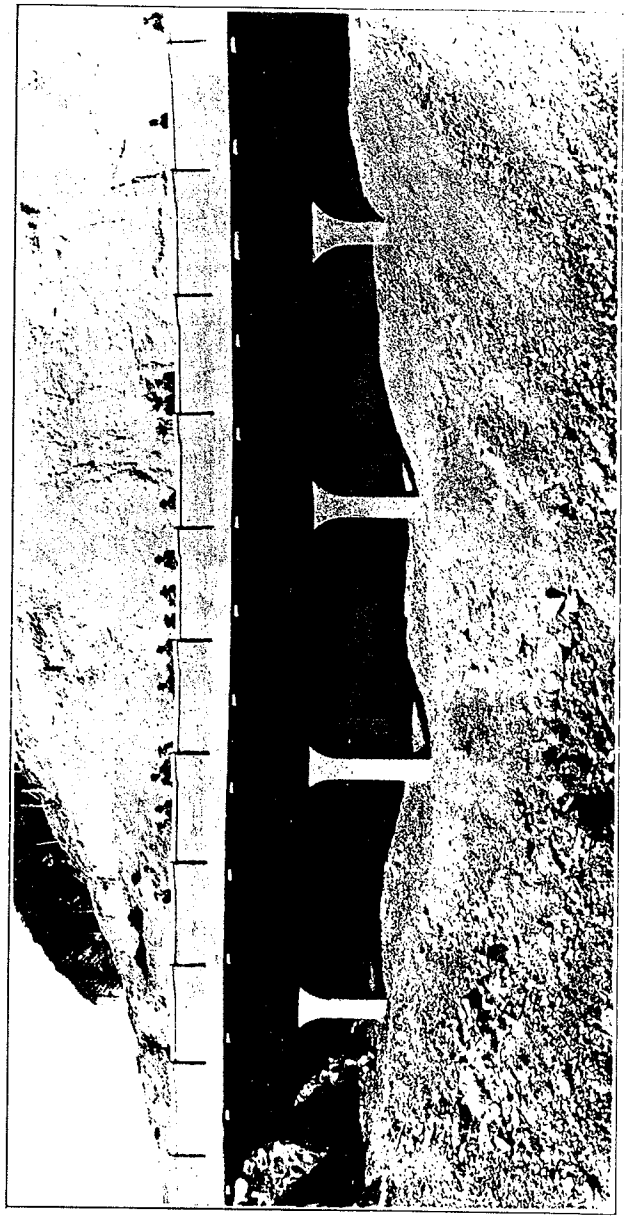
Point Lobos Avenue:

One of the most important roadway projects instituted and completed during the past year was the improvement of Point Lobos Avenue, commonly known as Cliff House Road, from Forty-eighth Avenue to the north end of the Great Highway, being practically the continuation of the latter highway northerly around Sutro Heights.

The Cliff House Road, in its most picturesque setting, with the steep unstable slopes of Sutro Heights on one side and the precipitous cliffs and Pacific Ocean on the other, has been traveled by practically every visitor and resident of our City since the early days of San Francisco. It is as



POINT LOBOS AVENUE
Upper section around Sutro Heights.



VIADUCT, SUTRO HEIGHTS, LOOKING SOUTH ALONG GREAT HIGHWAY

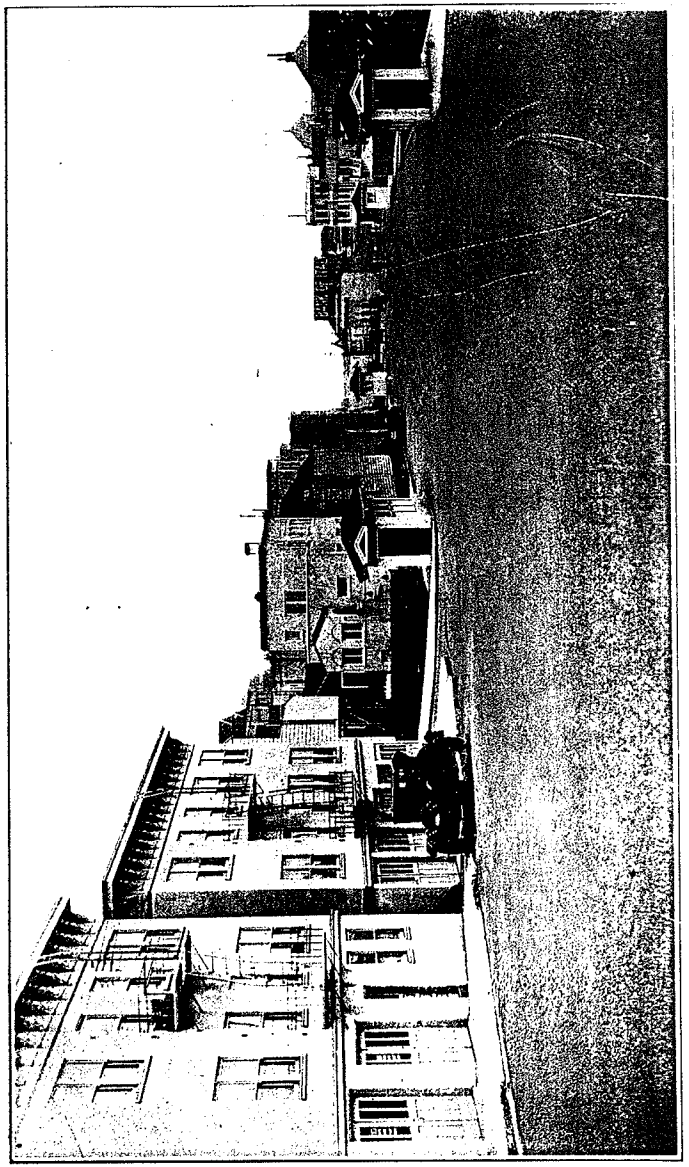
known as Market Street, sharing its fame throughout world with the Cliff House and the Esplanade.

The topographical situation, while an aesthetic benefit, presented many difficult problems in the attempt to construct an 80-foot highway in place of the old narrow road. The resulting highway, 2,400 feet in length, with a maximum grade of 9 per cent, has been proclaimed by press and public of the most magnificent driveways, ranking with our world-famed Twin Peaks Drive as a scenic boulevard and an example of up-to-date engineering. A broad winding 60-foot wide roadway, paved with asphaltic concrete on each side of a brick center strip, and with an adjoining 20-foot cement walk, is supported on the Ocean side by massive rubble walls laid in concrete. The highway spans a rock gorge by means of a reinforced concrete half-bridge, 173 feet in length. The slopes of Sutro Heights have been cut back to insure stability, over 39,000 cubic yards of excavation being necessary in the construction of the roadway, mostly in trimming the slopes. The other features of construction included 134,000 square feet of asphaltic pavement, 7,700 square feet of stone sidewalk, 4,300 cubic yards of rubble masonry wall, 3,930 feet of ironstone pipe sewer, 10 manholes and 20 catchbasins. A system of ornamental lighting standards and electric lights was installed, adding to the beauty and utility of the improvement.

The contract for the work was awarded on September 23, 1921, and construction was completed in the early part of June 1922, in time for the great influx of Eastern visitors brought to San Francisco by the many conventions held here this year. The construction involved a total expenditure of $190,000.

Market Street Extension:

The paving of the easterly section of this boulevard, as described in our last report, was completed during the early



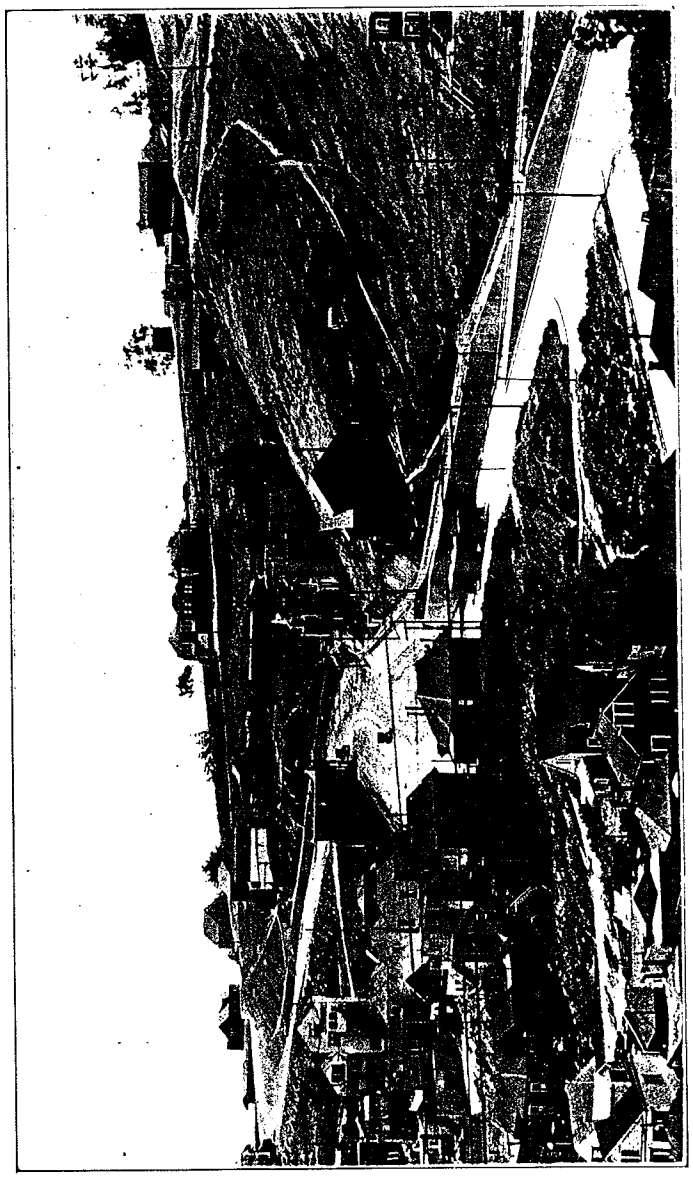
part of this fiscal year. In addition to this, there has been completed the grading and sewering of a section from the easterly termination of Mono Street to a junction with Carroll Road at Twenty-fourth Street, and the paving has also been contracted for under public proceedings. This section of the boulevard extends approximately 3,850 feet and has a 46-foot roadway and 8-foot sidewalks.

The contract for grading and sewers included 41,600 cubic yards of excavation, and construction of five retaining walls and over 5,800 feet of sewers. The estimated quantities of work under the present paving contract include 170,500 square feet of asphaltic concrete pavement, 55,000 square feet of artificial stone sidewalks and 6,700 feet of concrete curb. The cost of paving this section will be assessed to the property owners, up to a rate of $10 per front foot, any excess above this amount will be paid for by the City.

The completion of this section will provide a direct paved route from the Ferry Building via Market Street, Market Street Extension, Eighteenth Street, Portola Drive, to Junipero Serra and Sloat Boulevards, thus shortening the distance between the western residential district and the main business district of the City. Formerly, travel between these districts was compelled to take a circuitous route over Haight or Fell Street and Lincoln Way to Nineteenth Avenue, or a southerly route over Valencia and Mission Streets and Ocean Avenue.

Great Highway:

The paving of the easterly portion of the Great Highway from Fulton Street to Lincoln Way has been completed. This contract, awarded on May 21, 1920, covered the paving of 141,326 square feet, being a strip 43 feet wide along the Ocean frontage of Golden Gate Park, the width of paved roadway in this section of the Highway now being 83 feet.



MARKET STREET EXTENSION, LOOKING SOUTH FROM FIFTH STREET

The contract for paving of the westerly portion of the Great Highway between Balboa and Cabrillo Streets, awarded on July 2, 1920, has been completed, and included, with 36,350 square feet of paving, the construction of coping and walks about the new Comfort Station at the beach.

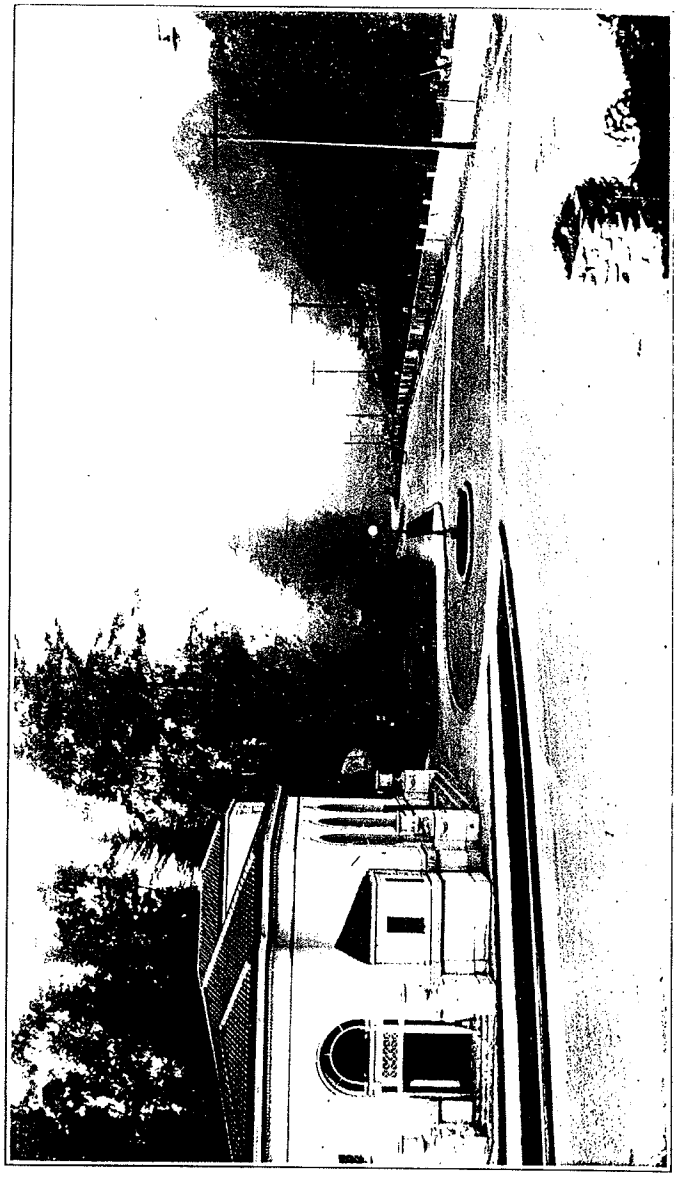
A contract has been let for the paving of the westerly portion of the Great Highway from Cabrillo Street to Fulton Street. This improvement is adjacent to the recently completed section of the Esplanade, and will complete the paving of the Great Highway between Point Lobos Avenue and Fulton Street to a full width of 150 feet, which is contemplated to be carried eventually across the Park frontage to the junction of the upper and lower roadways.

Sloat Boulevard:

The paving of a 30-foot strip on the northerly half of Sloat Boulevard from Great Highway to Fortieth Avenue was extended in the same contract to Thirty-fifth Avenue. The proposed full width of 135 feet will consist of a 20-foot sidewalk and parking strip and a 30-foot paved strip on each side of a 35-foot street railway right of way. The southerly strip of pavement has been in use several years and the northerly section from St. Francis Circle to Nineteenth Avenue and from Thirty-fifth Avenue to Great Highway is now paved. The last contract just completed added 126,000 square feet of paved surface to this highway.

Laguna Honda Boulevard:

The boulevard extending from the southerly end of Seventh Avenue around the Laguna Honda Reservoir of the Spring Valley Water Company to Dewey Boulevard was improved. From Lawton Street to Plaza Street, around the reservoir, being 3,845 feet in length, the road was paved in a temporary manner with an asphaltic concrete surface of 2 inches minimum thickness on the existing macadam base,



minimum width of 12 feet being maintained. A design for permanent road around this reservoir has been made and will be constructed in the future when the final determination as to how much this reservoir will be enlarged, is reached. From Plaza Street to Woodside Avenue, over square feet of pavement, consisting of 1½-inch asphaltic concrete wearing surface on a 6-inch concrete base, was constructed. The Relief Home Tract and also the Laguna Honda Station of the Twin Peaks Tunnel front upon this latter section. The improvement of this road provides a paved thoroughfare from Golden Gate Park to the Dewey Boulevard and connecting highways.

Geneva Avenue and Walbridge Street Improvement:

The existing road through Visitacion Valley was improved by rolling an 8-inch course of broken rock on a 12-foot strip. This improvement runs along Geneva Avenue from Prague Street easterly and thence along the existing roadway to Walbridge Street, thence along Walbridge Street to the County Line. The roadway below the County Line to San Bruno Avenue has been similarly improved and Geneva Avenue has been paved from Prague Street to Mission Street. This route is the only improved through route between San Bruno Avenue and Mission Street south of Silver Avenue and provides a means of diverting traffic between these highways.

Divisadero Street Widening:

Divisadero Street, one of the old built-up streets of this City, has developed into a main crosstown thoroughfare. This street, with a double track railway in the center of a 44-foot 6-inch roadway and with 19-foot sidewalks on each side, acquired such traffic that it became necessary to widen the roadway. Eight feet were added to the width of the pavement for a distance of 20 blocks between Haight Street

and Clay Street, by reducing the sidewalks on each side to 15 feet.

In the design of this work, special attention was given to the existing improvements so as to minimize the amount of conform work and to create the least disturbance to the traffic. It was necessary to construct 47,790 square feet of asphaltic concrete pavement and to place only 7,385 square feet of conform surface on the undisturbed portion of the adjoining pavement.

In addition to this 12,670 lineal feet of granite curb was redressed and reset, 69 catchbasins were reset and culvert pipes connected and 199 sewer traps and connections reconstructed.

The total cost of this work was $31,563.70, of which amount the property owners were pledged to pay $17,081.7., being at the rate of $1.5859 per front foot. The balance of the cost, together with the cost of setting back the fire hydrants and inspection fees, was borne by the City.

This improvement has proven satisfactory in relieving the traffic congestion on this street, which fact alone well repays the property owners for the amount of their contributions.

Castro Street Widening:

A contract for widening Castro Street from Seventeenth Street to Nineteenth Street has been let and the work partially completed.

This improvement is similar to that on Divisadero Street and consists in widening the roadway 4 feet on each side for a distance of two blocks by setting back the curbs and reducing the walks accordingly. This work is estimated to cost $8,350, which cost the City and property owners will share alike.

San Jose Avenue, Ottawa Avenue to Sickles Avenue:

This portion of San Jose Avenue has been widened to a uniform width of 80 feet, the City purchasing the necessary property on the easterly side of the avenue. In addition to paying for the property, the City contributed $30,000 towards the cost of grading and paving, and this improvement is nearly completed. Before the southerly end of this avenue, between Sickles Avenue and the County Line, can be widened and improved it will be necessary to replace the narrow wooden bridge over the Ocean Shore Railway at Regent Street and San Jose Avenue with a wider, more suitable structure. The northerly end of this improvement is intended to merge into the Bernal Cut.

Proposed Boulevards:

Surveys have been made and tentative plans prepared with a view to the acquisition of necessary lands for the **Telegraph Hill Boulevard** and also for the extension of the **Marina Boulevard** to the Presidio.

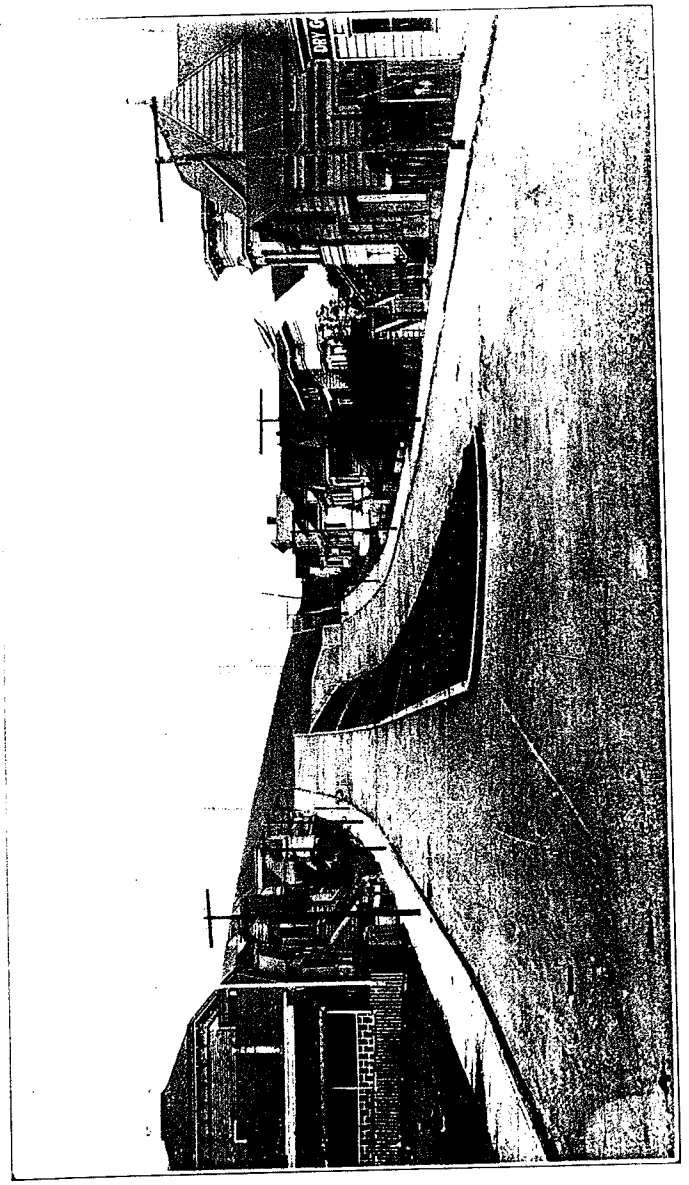
Roosevelt Way: Practically 95 per cent of the property needed for Roosevelt Way has been acquired and a contract for part of this improvement should be let shortly. This boulevard will extend from Fourteenth and Alpine Streets to Seventeenth and Clayton Streets, and traverse a district that at the present time has no main artery of easy gradient. It will be approximately 3,900 feet long, 60 feet in width with 6-foot sidewalks. The maximum gradient will be about 10 per cent. Retaining walls will have to be used quite extensively, the highest wall measuring about 15 feet in height.

Bernal Cut: Plans, both in perspective and section, of the Bernal Cut improvement were prepared and show the important relation of this proposed boulevard to the surrounding district. The improvement would consist of widen-

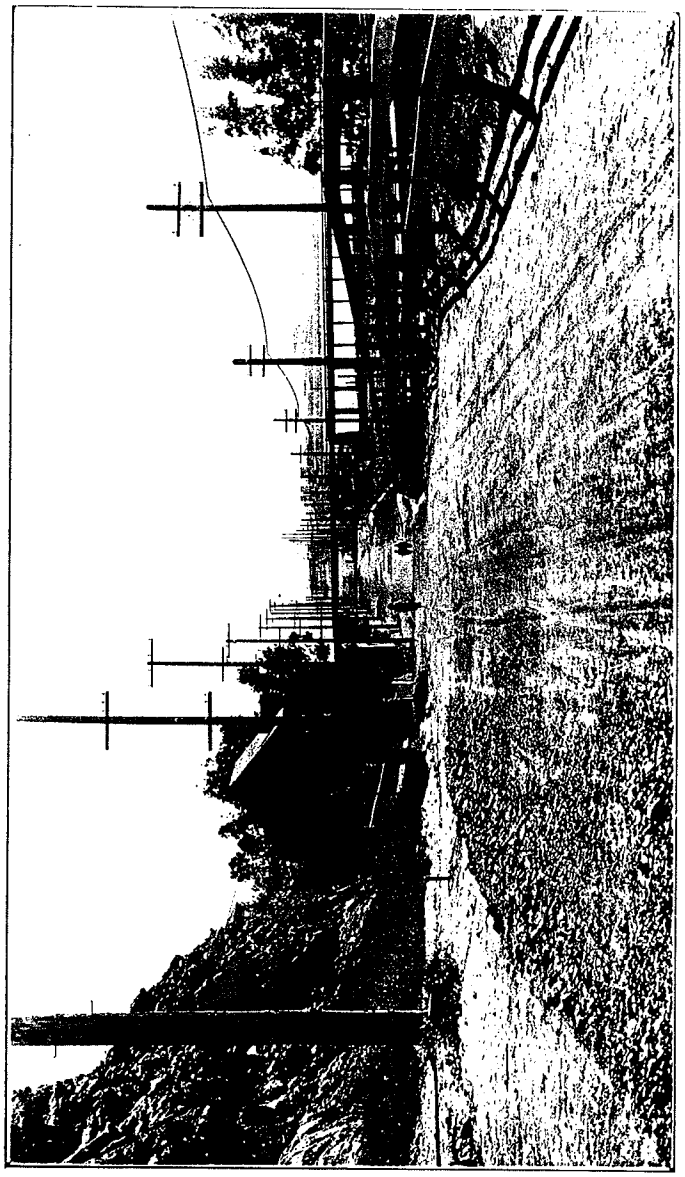
ing the cut of the Southern Pacific Railway from Randall Street southerly to San Jose Avenue to a clear width at the bottom of 116 feet, and thus provide room for a 42-foot roadway, a double track street railway line, a double track suburban line of the Southern Pacific Company and an 8-foot sidewalk. The right of way through the existing Bernal railway cut was secured for the City as a part of the Southern Pacific Company's franchise at Third and Townsend Streets. The necessary grading to accommodate the paved roadway was made an obligation of the railway company. The completed roadway will be the northern link of a new boulevard extending from the County Line along San Jose Avenue and through Bernal Cut to the southerly termination of Dolores Street. From Ocean View northerly 4,000 feet of San Jose Avenue has been widened to a uniform width of 80 feet. Another mile to Sunnyside Avenue is being prepared by obtaining rights of way, etc., so that the approaches of the "Cut" from the south will be completed at an early date.

Special Street Improvements:

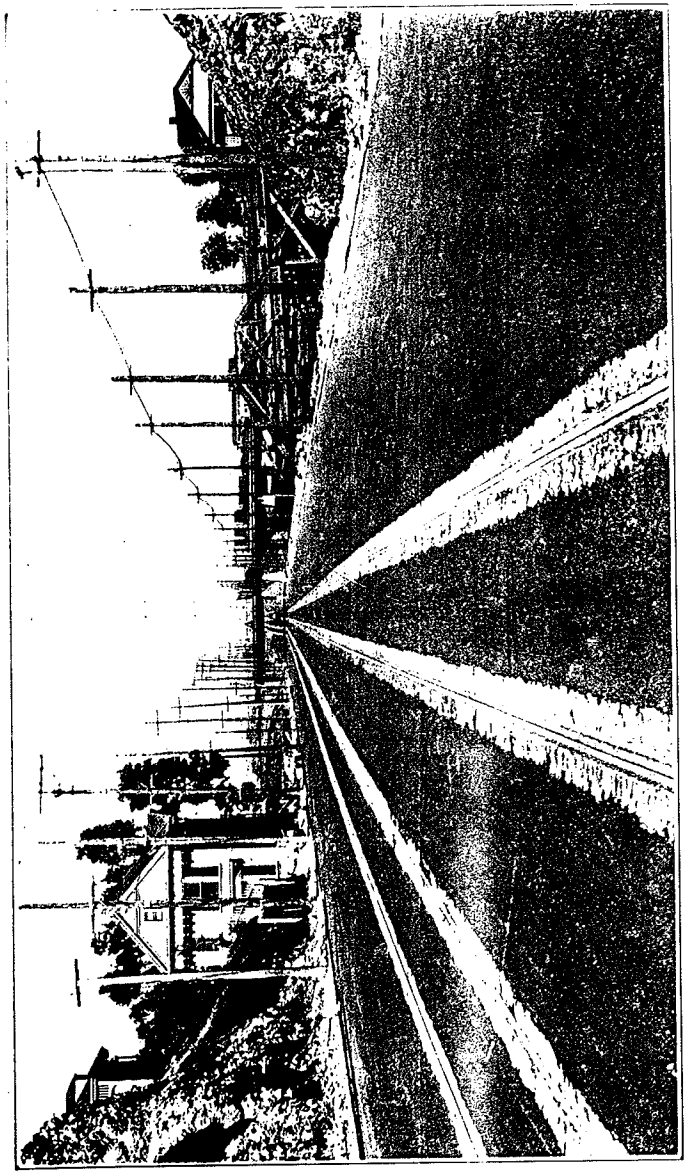
One of the larger special local improvements upon which construction has commenced is the grading, sewering and construction of walls on Liberty Street from Noe to Church Street and Sanchez Street from Twentieth Street to Twenty-first Street. Plans have been drawn up and proceedings for the ordering of the work started many times in past years, but heretofore it has been impossible to satisfy even a majority of the property owners with the proposed plans. The evil of a rectangular system of streets on a steep hillside is well illustrated by this case. Combined with this handicap is the fact that property owners have erected homes on the abutting properties without regard to any practical plan for street improvements. The work under way is estimated to cost approximately $60,000, towards which the City



SPECIAL TREATMENT IMPROVEMENT ON QUESADA AVENUE.
Showing double roadway with wall and turning space at further end.

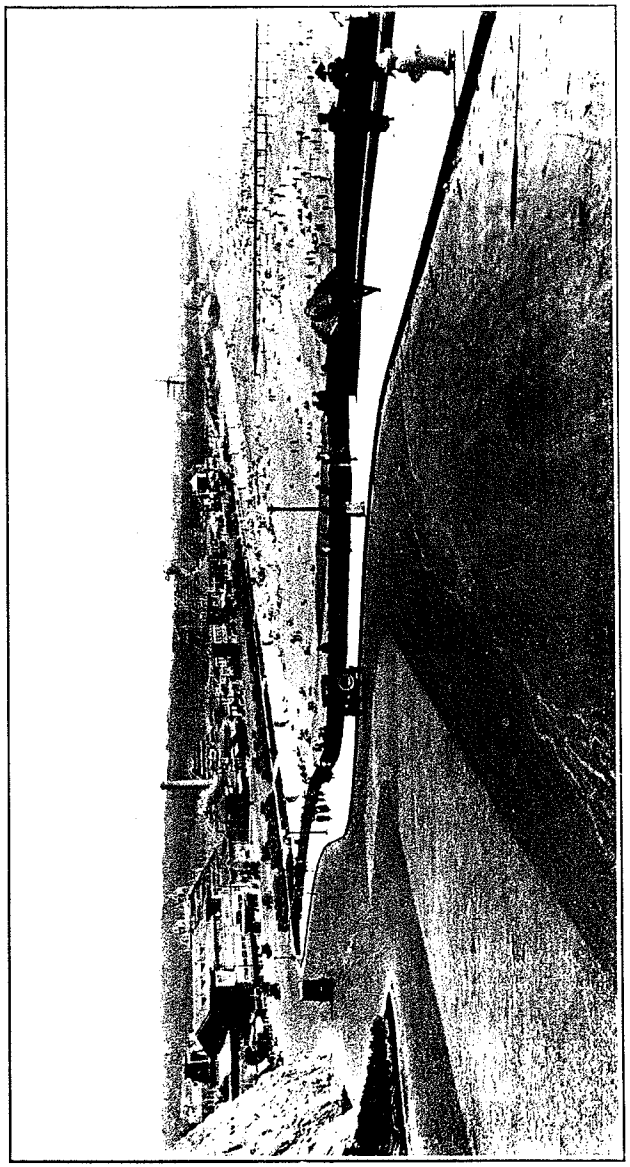


ARMY STREET [illegible] WIDENED



ARMY STREET WIDENED, PAVED AND WITH STREET RAILWAY

This view looking easterly after improvement of the street is of the same section of Army Street as shown in preceding illustration.



OCEAN BEACH ESPLANADE AND THE GREAT HIGHWAY

This construction will ultimately extend for three miles along the entire length of the Great Highway at Ocean Beach, between Lincoln Avenue and the Cliff House.

of this section of Esplanade involved also a large concrete conduit to accommodate the intake pipes of the Olympic Salt Water Company and also the Trans-Pacific cable lines. When this section is completed there will be a total length of 1,740 feet of Esplanade completed.

In furtherance of the policy of this office to build a section of the Esplanade each year, the Board of Supervisors has been requested to include the sum of $150,000 in the new budget for the construction of Section "D" of the Esplanade.

Columbia Heights Fire Cistern:

A reinforced concrete cistern of 75,000 gallons capacity was constructed at the intersection of Lakeview and Josiah Avenues to provide fire protection for the surrounding Columbia Heights District. This district lacks the water supply and necessary pressure for fire fighting purposes. The cistern cost $6,885 and is of the standard type adopted by this department in previous years—30-foot interior diameter with vertical walls and spherical shaped dome and bottom. With the completion of this cistern there are now in use 142 cisterns, 86 of 75,000-gallon capacity and 56 of various capacities.

Street Signs:

Three hundred seventy-one street signs of the most modern pattern were erected at a cost of $7,000 in the downtown district, east of Van Ness Avenue and Eleventh Street and north of Townsend Street. These signs consist of four 5-in.x22-in. porcelain enamel plates, with 3-inch white lettering on a blue background, mounted in metal frames and erected on 3-inch standard pipe posts set in concrete, the signs being 9 feet above the sidewalk level. A study has been made for the systematic location of signs throughout the entire City and

STREET SIGN
Modern type of sign erected for marking the city streets.

a program of erecting signs will be followed as funds are available. With the appropriation of $7,500 which has been included in the budget for this year, it is planned to extend the signs to Divisadero Street on the west and Sixteenth Street on the South, and also to place signs along some of the most important thoroughfares outside of this district, such as Mission Street, Third Street, Lincoln Way, Fulton Street, Geary Street, etc. With an appropriation of $10,000 annually for the next two or three years, the streets of this City will be well marked, and then the cost of signs for new streets and for upkeep will be nominal.

Public Comfort Station:

There has been completed and put in use, at a cost of $32,966.13, a commodious, modern underground convenience station at the Ocean Beach Esplanade. This station, which has been fully described in a previous report, has been operating satisfactorily and will be a model for the many comfort stations which it will be necessary to construct in this City. An appropriation of $20,000 has been made in the Budget for the coming year for the construction of a convenience station which will be situated in the downtown business district.

Board Walk Along Great Highway:

Two thousand five hundred feet of Board Walk was constructed along the Upper Roadway of the Great Highway from Sloat Boulevard northerly. This marine driveway has been a popular "hike" for pedestrians, and to provide a walk free from the dangers of the congested highway, a walk 10 feet wide was constructed. This walk, as funds are provided, will be extended the full length of the Upper Roadway. In succeeding years, when the seawall will have been extended southerly, the temporary board walk will be replaced by the

REPORT

OF THE

BUREAU *of* ENGINEERING

OF THE

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF
SAN FRANCISCO

FISCAL YEAR ENDING JUNE 30, 1923

JAMES ROLPH, Jr. - - - *Mayor*

TIMOTHY A. REARDON
DANIEL G. FRASER
CHARLES E. STANTON
Board of Public Works

M. M. O'SHAUGHNESSY
City Engineer

IN MEMORIAM

FREDERICK M. HYDE
Engineering Draftsman
Service—14 years
Died—October 29, 1922

JAMES REAVY
Engineering Chemist's Assistant
Service—18 years
Died—November 10, 1922

CHARLES H. HOLCOMB
Assistant Civil Engineer
Service—34 years
Died—January 25, 1923

LOUIS D. SLOSS
Clerk
Service—19 years
Died—March 25, 1923

WILLIAM D. EVANS
Surveyor's Field Assistant
Service—23 years
Died—May 20, 1923

BLISS D. RICKEY
Surveyor's Field Assistant
Service—23 years
Died—June 3, 1923

BOULEVARDS, STREETS AND HIGHWAYS

Several sections of San Francisco's excellent boulevard system have been completed during this fiscal year, namely:

Market Street Extension, Mono Street to Twenty-fourth Street;

Sloat Boulevard, northerly half, Nineteenth Avenue to Thirty-fifth Avenue;

Great Highway, westerly half, Cabrillo Street to Fulton Street.

In addition, construction was started on two other sections which, when completed, will provide for the traffic over them magnificent panoramic views of the City, bay and ocean and which will rightly share the world-wide renown of Twin Peaks Boulevard, the Great Highway and other sections of our boulevard system as scenic highways. The two sections under way are the Telegraph Hill Boulevard, circling the landmark of that name, and the boulevard from Lincoln Park to Sutro Heights.

Also several local special treatment improvements were under construction, the most important being the Liberty and Sanchez Street improvement and the Collingwood and Twenty-first and Twenty-second Street improvement.

The cost of street improvements constructed under public, private and City pay contracts during the year was approximately $1,400,000.00. Among these improvements were the following:

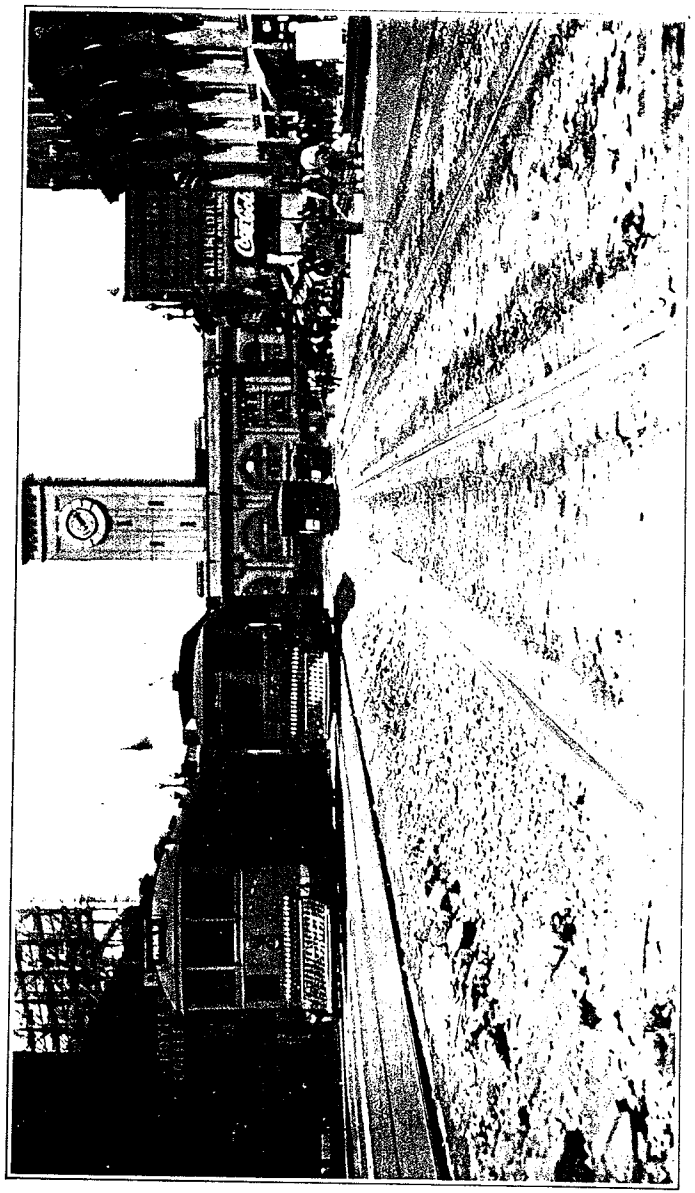
Valley Street, Noe Street to Castro Street;

Bay Street, Van Ness Avenue to Laguna Street;

La Plaza, Balboa Street to Fulton Street;

Taraval Street, Thirty-seventh Avenue to Forty-eighth Avenue.

Mission Terrace.



The reconstruction of Market Street from The Embarcadero to Sansome Street, by the Bureau of Street Repair for the Market Street Railways, is being done with the co-operation of this department. Complete working diagrams and profiles were prepared for this work, which includes the raising of the tracks and street to the official grade. As this street has been settling at an approximate rate of 1½ inches a year, there has been a maximum settlement of two feet in some places since the last reconstruction in 1907, thus making this a work of some magnitude. While the modern large buildings adjoining this street have been constructed on piles, many of the older and smaller buildings do not this solid foundation and consequently have also settled. The bringing up of the street to grade will necessitate reconstruction of sidewalks by the owners, and, in many cases, rearrangement of entrances and floor levels. Special study has been given this problem in order to produce the desired result with the least possible disturbance of the existing improvements.

Besides Market Street, the reconstruction program of the Bureau of Street Repair called for an expenditure of approximately $350,000.00, for all of which reconstruction this office prepared working diagrams. Jones Street, from Golden Gate Avenue to Post Street, and McAllister Street from Franklin west, reconstructed and widened by reducing sidewalk widths, involved considerable study and fitting of grades to existing improvements.

Market Street Extension:

Market Street Extension is part of the direct route from the Ferry Building to the junction of Junipero Serra and Sloat Boulevards, connecting the southwestern residential section with the main business section of the City, and also providing a new main thoroughfare out of the City, connecting with the present peninsula highways, thus relieving the present congested streets of the City from some of the peninsula-bound traffic.

MARKET STREET EXTENSION, MONO STREET TO TWENTY-FOURTH STREET
Before improvement (looking south)

MARKET STREET EXTENSION, MONO STREET TO TWENTY-FOURTH STREET
After improvement (looking south)

The paving of this thoroughfare from Mono Street to its junction with Corbett Avenue at Twenty-fourth Street was completed at a cost of about $80,000.00. This section was formerly known as Falcon Avenue. In addition to purchasing the necessary land for widening this section of Market Street and assuming the cost of grading and sewers and retaining walls, the City has paid almost half the cost of the paving under this last contract. The property owners were assessed only up to a rate of $10.00 per front foot for the paving of this boulevard.

Land is being acquired and plans and specifications prepared for the construction of the connecting link between this upper section and the lower section of the Market Street Extension. Meanwhile, traffic is routed over Eighteenth Street and Falcon Avenue between the two improved sections.

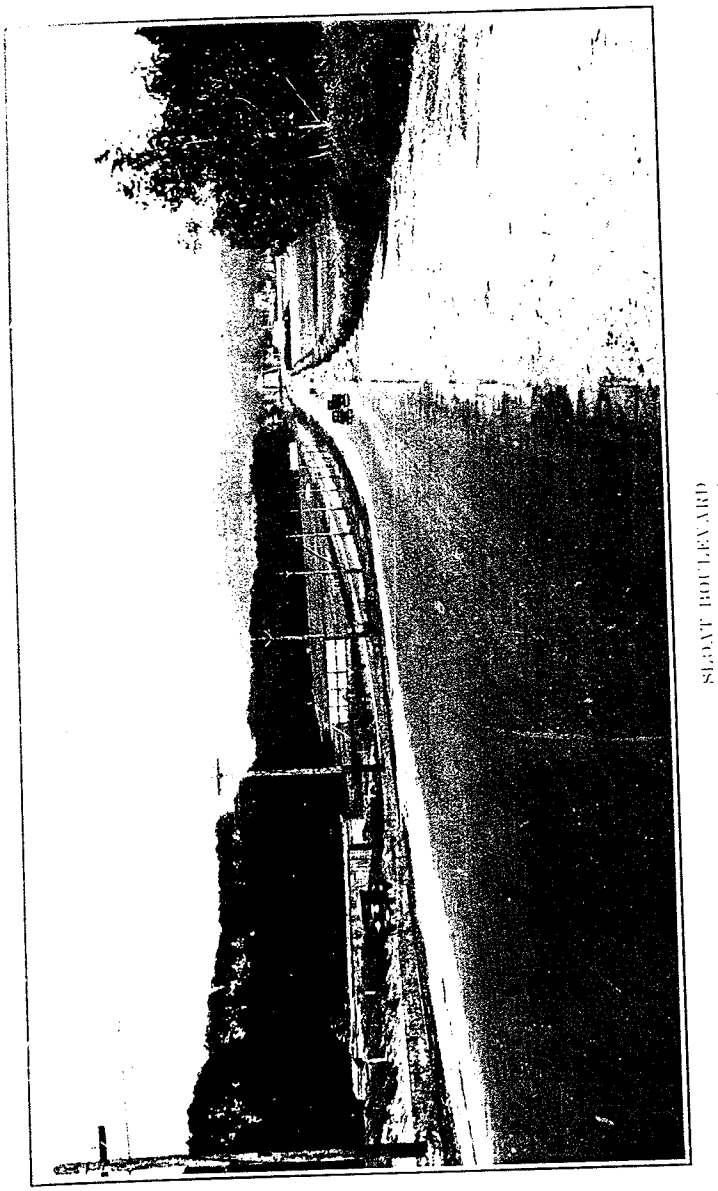
Sloat Boulevard:

The double roadway of Sloat Boulevard for its entire length is now paved, being completed by the recent contract which covered the northerly half between Nineteenth and Thirty-fifth Avenues.

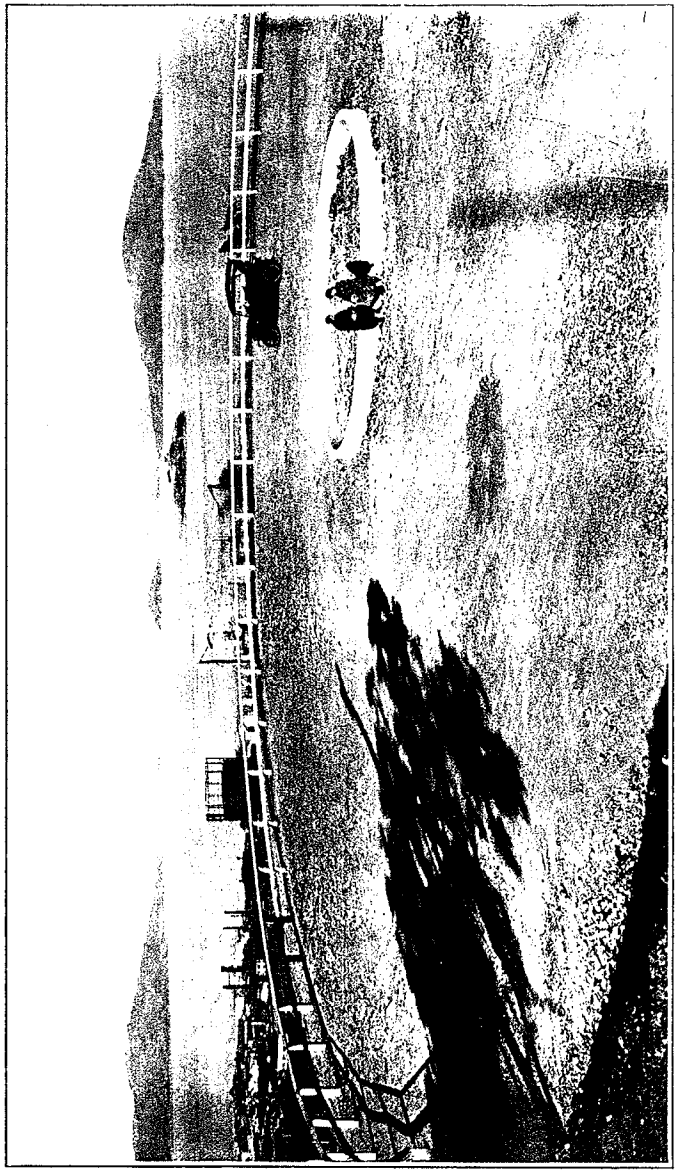
A contract for the improvement of the junction of Sloat Boulevard, Great Highway and the Skyline Boulevard has been awarded and construction is now under way. One of the principal features of this improvement is an underground pedestrian passageway beneath the southerly paved strip of Sloat Boulevard from a ramp at the terminus of the street railway line and leading to the new Municipal Playground and Swimming Pool. With the completion of the Skyline Boulevard and the playground and pool, this junction will be called upon to carry a large amount of automobile traffic, especially on Sundays and holidays.

Great Highway:

The improvement of the Great Highway between Point Lobos Avenue and the North Drive in Golden Gate Park to the full width of 150 feet will soon be complete, the last



SLOAT BOULEVARD
Looking east, showing completed pavement.



TELEGRAPH HILL BOULEVARD
Parking Circle — Top of Telegraph Hill

contract for paving the westerly portion between Fulton and Cabrillo Streets having been completed during this fiscal year. Bids are now being called for the extension of the paving on the westerly portion from Fulton Street southerly, fronting on the recently completed Section "D" of the Esplanade.

Telegraph Hill Boulevard:

Beginning at Kearny and Lombard Streets, this boulevard winds about Telegraph Hill at a maximum grade of 9.23%, for a length of approximately 1150 feet, and ends in a parking circle at the peak of the hill. The width of finished roadway will be 22 feet, widened to 27 feet on the sharpest curves.

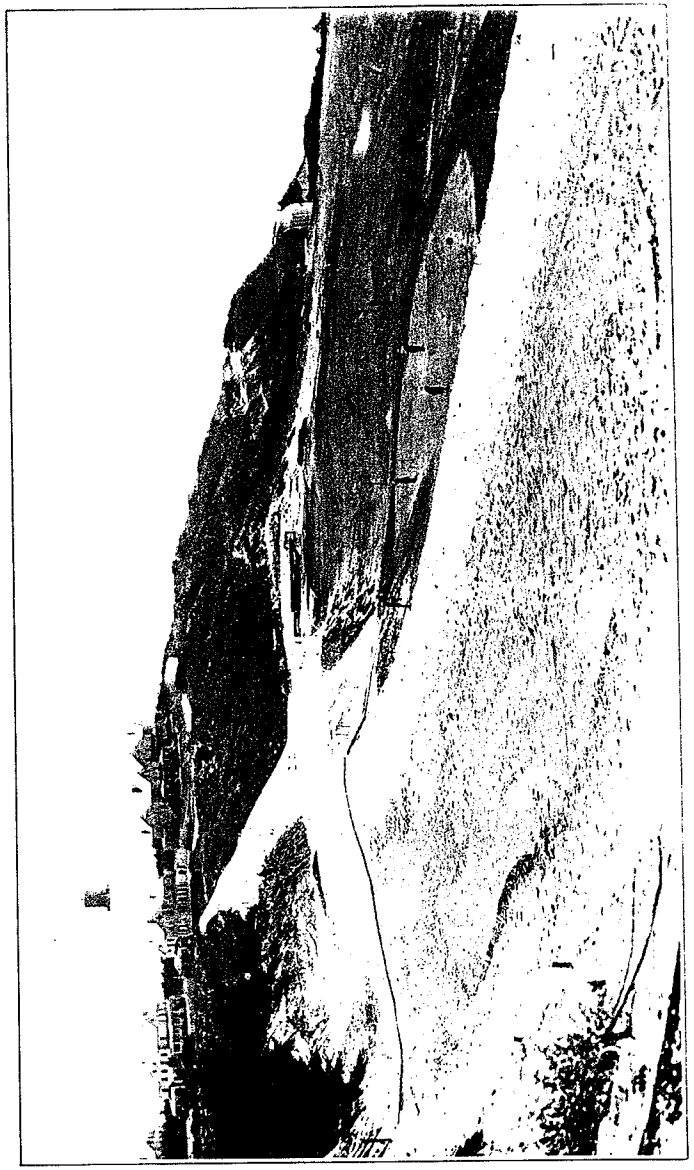
From the parking circle at the top of the hill, the motorist will have a wonderful view of the northeasterly sections of the City, including the docks and shipping, of San Francisco Bay and the Golden Gate, and of Sausalito and the East Bay communities. The City has purchased additional lands on the hill, necessary for the road, and will assume the total cost of this improvement.

The present contract includes the grading of the road and drainage ditches, and construction of walls, guard fence and catch basins. Paving of the road will be done under a separate contract the following year, after allowing the fills to settle sufficiently.

Lincoln Park Boulevard:

Unlike Telegraph Hill Boulevard, which is in itself a unit of the City's system of boulevards, the road under construction through Lincoln Park is a connecting link in the twenty-mile drive circumscribing the entire western half of the City, of which the Marina, Camino del Mar, Point Lobos Avenue, Great Highway, Sloat Boulevard, Portola Drive, Twin Peaks Boulevard, Market Street and Van Ness Avenue are component parts.

This section connects with the recently paved Point Lobos Avenue at Forty-eighth Avenue, from which point it



...utherly to the northwesterly corner of Fort Miley ... Reservation and thence easterly along the cliffs, ... the northerly boundary of the Reservation and the ... of the Market Street Railway and through the ... Golf Links in Lincoln Park, joining the present ... Lincoln Park near the new Legion of Honor Me... Building. Traversing this boulevard, one has a view ... Pacific Ocean and the Golden Gate, which has for... been denied the motoring public through lack of a ... ay along these cliffs.

The length of this section is 4300 feet and the maxi... grade 6.58%, the grade over the greater length being ... than 1%. The width of the graded road will be 60 ... which will allow a 50-foot roadway with a 10-foot ... on one side.

The contract now under way includes grading, gravel ...facing, guard fence and drainage and two small sec... of retaining wall. The grading includes approxi... ly 60,000 cubic yards of cut, and over 3,000 cubic ... of gravel surface will be laid. Permanent pavement ...ll not be laid until the new fills shall have become stable.

Signal apparatus in the United States Reservation had ... be moved and arrangements made with the War Depart... ...ed for this purpose.

Special Street Improvements:

The grading and construction of retaining walls on the **Liberty Street** (Church to Noe Street) and **Sanchez Street** (Twentieth to Twenty-first Street) improvement, as described in the last report, were completed. The paving of these blocks will be placed during the coming year, as the sum of $37,000.00 has been included in the Municipal budget for 1923-24 for this purpose.

Another local special treatment improvement similar to the Liberty and Sanchez Street improvement is located on **Collingwood Street** from Twentieth to Twenty-second Street and **Twenty-first** and **Twenty-second Streets** from

LIBERTY STREET, LOOKING WEST FROM CHURCH STREET
Before improvement

LIBERTY STREET, LOOKING WEST FROM CHURCH STREET
After grading and construction of walls.

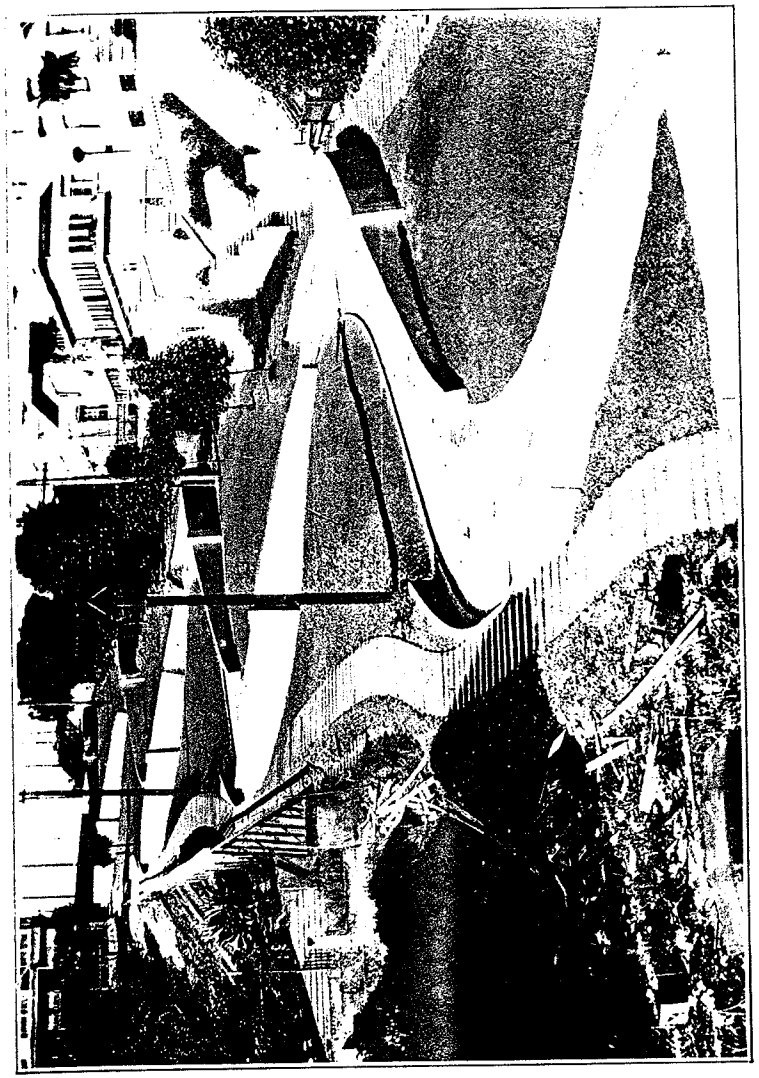
Castro to Diamond Street. These are typical illustrations of streets in a rectangular system on steep hillsides. That the owners of the abutting properties have built homes without regard to any plan for street grades and improvement, added to the difficulties of the problem. Many different plans were drawn up and rejected by the property owners before the final plan, under which the improvement is proceeding, was adopted. Even with this plan, some of the property owners protested against the improvement. By means of retaining walls, double roadways and steps, passable grades for traffic and pedestrian travel have been evolved. The grading, sewers and walls and stairs are being done under the present contract, at an estimated cost of $70,772.00, towards which cost the City has appropriated the sum of $22,500.00. Included in the City's budget for 1923-24 is the sum of $34,000.00 for the paving of this improvement.

Plans for the improvement of **Lombard Street** between Hyde and Leavenworth Streets were prepared by this office and the work was done by the Bureau of Street Repair. This improvement, consisting of a winding brick pavement, 15 feet in width, supported by curving retaining walls, has resulted in a 19% grade in place of the almost impassable 26% grade of the old cobblestone straight roadway.

Proposed Boulevards and Local Improvements:

San Francisco's quota for 1923-24 from the State funds collected through the licenses and taxes of motor vehicles will aggregate approximately $700,000.00. It is proposed to expend this sum as follows:

Bay Shore Highway to be used by State Highway Commission	$500,000.00
Skyline Boulevard (Joint Highway Dist. No. 1) Fencing	30,000.00
Virginia Avenue Widening	30,000.00
San Jose Avenue Widening, Cotter St. to Geneva Avenue	18,000.00
Avalon Avenue Extension	20,000.00
Silver Avenue, Mission Street to San Bruno Avenue	25,000.00
Marina Boulevard	80,000.00



LOMBARD STREET, LEAVENWORTH STREET TO HYDE STREET
Winding roadway on 19% grade replaces old 26% cobble stone pavement.

Bay Shore Highway: Through concerted action of the Supervisors of San Francisco and San Mateo Counties tentative highway district comprising the two Counties was formed for the construction of a highway from San Francisco through San Mateo County and also including a connection to and a proposed bridge across San Francisco Bay near Dumbarton Point. In order to facilitate the preliminary work, the project was divided into sections, this County, San Mateo County, and the State Highway Commission each being given a section on which to prepare preliminary surveys and tentative plans and estimates. This department prepared a report covering the northerly section from Army Street and Potrero Avenue in this City to San Mateo; the report of the San Mateo County Engineer covered the section from San Mateo to Redwood City and the connection to and the proposed bridge were reported on by the State Engineer.

The following is a copy of the report of this department as submitted to the Board of Directors of the Joint Highway District:

"San Francisco, August 24, 1922.

To the Joint Highway District No. 4:

Gentlemen:

Pursuant to a meeting held on June 29th in the Division Headquarters of the State Highway Commission, in San Francisco, and participated in by your Commission, the Chief Engineer of the Highway Commission, the County Engineer of San Mateo County, the Highway Commission of the State of California and Assistant Engineer C. E. Healy, of this department, it was agreed that the work of making the necessary preliminary surveys and estimates of cost for the construction of the proposed highway from the intersection of Potrero Avenue and Army Street in San Francisco, through San Francisco and San Mateo Counties via Dumbarton Cut-off to a point on the main highway through Alameda County near Niles, should be divided as follows:

San Francisco to have the section between Army Street and Potrero Avenue and South San Francisco, County

Engineer Kneese of San Mateo County, the section between South San Francisco and Redwood City, and Mr. Fletcher, the State Engineer, the section between Redwood City, Dumbarton Cut-off and a connection with the main highway in Alameda County near Niles.

Before starting this work, I made a thorough study of the traffic conditions of today and the anticipated future needs of this city and the adjacent county and the effect that the proposed road would have in the growth and development of the contiguous territory. I decided that a right-of-way 125 feet in width should be acquired at this time, which would ultimately permit of 100-foot permanently paved roadway with 12½-foot sidewalks.

It is obvious that a complete program of this magnitude could not be undertaken at this time, as it would be difficult to finance, and in the estimate that I have prepared, I have provided for the initial acquisition of the full width right-of-way, the grading of this entire right-of-way wherever the costs were not prohibitive, the construction of macadam pavement on the finished fill 40 feet in width and 6 inches thick, which would carry the traffic for a period of at least two years, the time necessary for the proper settlement of the fills. At the end of this period, I have provided that the macadam pavement should be topped with a permanent concrete pavement 40 feet in width, 11 inches in thickness at the shoulders, 8 inches on the crown with 8-foot shoulders. (A detail of this construction is incorporated in the report to follow.)

The distance from Potrero Avenue and Army Street to the overhead crossing of the Southern Pacific Railroad at South San Francisco, by the proposed line is 7½ miles and the distance between South San Francisco and San Mateo is 7 miles. As a comparison, the distance between San Mateo and Fifth and Market Streets, via the State Highway and Mission Street, is 17.7 miles. The distance of the new road between the same points is 14½ miles. The new road, therefore, is 3.2 miles shorter. There will be no grades on the new road in excess of 6% and the curves will be of long radius, making it safe for traveling, and with the overhead crossing at South San Francisco all level grade crossings of the Southern Pacific lines will be eliminated.

In closing, it is my belief that the construction of this road is of primary importance for the relief of congestion and should be speeded up as fast as possible. I think,

however, that the undertaking is of more than local importance and that a portion of the cost should be borne both by the State and Federal Governments.

Enclosed please find detailed estimate of the proposed line, maps showing alignment and a detail of the proposed permanent construction.

Respectfully,

(Signed) M. M. O'SHAUGHNESSY,
City Engineer."

ESTIMATE FOR PROPOSED NEW HIGHWAY.

125 foot right-of-way. 100 foot paved.

		1st Installation of Construction.
Potrero Avenue and Army Street to County Line	2.80 miles	$1,500,000
County Line to South San Francisco	4.70 miles	936,000
South San Francisco to San Mateo	7.00 miles	1,036,000
	14.50 miles	$3,472,000

The Board of Directors of the district submitted a report to the Board of Supervisors of San Francisco and San Mateo Counties in which the following description of the tentative route of the proposed highway was given:

"Within the City and County of San Francisco, commencing at or near the intersection of Potrero Avenue and Army Street and thence southerly and easterly over existing highways, the same to be widened, straightened, extended and new grades established and reconstructed where necessary to the county line between said City and County of San Francisco and the County of San Mateo; thence in the same general direction partly over new and partly over existing highways and connecting the same where necessary, extending, widening, straightening, regrading and reconstructing such existing highways where necessary or convenient to a point in the vicinity of South San Francisco; thence along the easterly side of the Southern Pacific Railroad tracks in San Mateo County through Burlingame to a point near the intersection of Bay View Avenue and Howard Street in the City of San Mateo; thence southeasterly along Bay View Avenue to its southerly termination; thence in an approximately straight line to a connection with the Beresford road at or near its northerly termination; thence along said Beresford road to a point near the northerly limits of Redwood City; thence southerly on a convenient curve or line, crossing Redwood Creek immediately southerly of the S. H. Frank & Co. tannery and continuing in as direct a line as possible to a connection with the Middlefield road near the southeasterly limits of Redwood City; thence along the Middlefield road to the southern line of San Mateo County; also from a point on the line of said highway in Redwood City to near the railroad track running from said city to the Dumbarton bridge and paralleling said tracks as nearly as practicable, keeping southerly from Ravenswood Slough to a point on the southwesterly side of San Francisco Bay, and a bridge across said bay to a point near the mouth of Baird Creek on the northeasterly side of said bay."

The total approximate cost was estimated at $7,000,000, based on a proposed acquisition of right of way 125 feet wide and the construction of a paved highway 40 feet wide and a bridge of steel construction on concrete piers. The cost was to be borne by the two Counties in the ratio of their assessment rolls—San Francisco's portion being $6,600,000, and San Mateo's portion $400,000.

Arrangements between the two Counties, however, were not consummated and instead the Board of Supervisors of the City and County of San Francisco authorized an appropriation of $500,000 from the County Roads Fund to institute a start on the highway by the State Highway Commission of California. A bill was recently passed by the Legislature providing that this county may turn over a part of its automobile tax money, received from the State, to the State Highway Commission for the construction of connecting highways in San Mateo County.

Rights of way and plans will proceed on the basis of ultimately having a road 100 feet in width, with 12½-foot walks on either side, and of a type of construction that

will be the most perfect in highway work. The preliminary construction contemplates a 40-foot pavement at this time, to be widened as necessity requires. The entire project, when fully completed, will involve about 28 miles of construction, including that part within the City and County of San Francisco from Potrero Avenue and Army Street, and reaching to the Santa Clara County line.

San Jose Avenue: The amount of $18,000 contributed by the City towards the widening and improvement of San Jose Avenue between Cotter Street and Geneva Avenue is in accordance with the plan of improving this thoroughfare, under which plan the section between Sickles Avenue and the County Line has recently been completed. The owners of property needed for widening the street deed the necessary land and the City, in turn, assumes a part of their liability for paving, equal in amount to the value of the land taken. The improvement of the intermediate section, between Geneva Avenue and Sickles Avenue, cannot be made until the construction of new viaducts across the railway tracks at Sickles Avenue and at Mount Vernon Avenue.

Marina Boulevard: One of the many districts of the City which is rapidly being built up, is located on the Panama-Pacific Exposition site and fronting on the Marina Boulevard. The Board of Supervisors have adopted a resolution favoring the establishment of a building and grounds for industrial expositions at the Marina, and to initiate this development and improvement have included the sum of $100,000 in the budget for the coming year.

The making of a rock fill along the Marina Boulevard fronting on the Yacht Harbor has been under way—a contract for the same having been let. Over 22,000 tons of massive rocks have been dumped along the shoreline, forming a seawall behind which a fill will be placed to carry the boulevard. During the coming year, the sections on each side of the fill will be paved, funds for this being

provided as shown above. Following reconstruction of a short section of wood stave pipe sewer and the settlement of the fill, this intervening section will be paved, giving a continuous wide roadway along the bay shore from Fort Mason to the Presidio.

Silver Avenue: Silver Avenue is a through route of easy gradient between Mission Street and San Bruno Avenue and when paved will divert traffic between these highways. It is planned to grade the street and lay a 20 foot concrete roadway with necessary culverts and drainage appurtenances. Because of its importance as a cross-connecting thoroughfare between two main traveled routes, the City will contribute the sum of $25,000 towards the improvement and the property owners will pay the balance of the cost.

Avalon Avenue: The extension of Avalon Avenue from Lisbon Street to Mission Street through the lands of the Hebrew Home for the Aged will provide a short cut from Mission Street to the district east of the Home. The Trustees of the Home will donate the land necessary for the roadway, provided the Home is not assessed for the street improvement, and as the opening and paving of this street will be of benefit to a large territory, the City will pay the cost of paving the same.

Virginia Street: Another similar proposed and desirable improvement in the Mission District is the widening of Virginia Avenue from Mission Street to Coleridge Street. This street is the only easy gradient outlet to Mission Street for the surrounding district, but in this block it has only a width of 20 feet. In order to widen this to 60 feet, property must be purchased, so the City will share equally with the property owners of an assessment district to be formed to pay the costs of the property and improvement.

Market Street Extension Tributaries: The main thoroughfares tributary to the Market Street Extension are

being studied preparatory to improving them. **Grand View Avenue**, one of the principal of these thoroughfares, provides a low grade connection between the Mission District and the Market Street Extension. Plans are being prepared for the improvement of Grand View Avenue with two-level roadway, with grades less than 10%. **Corbett Avenue** from Twenty-fourth Street to Caselli is another tributary thoroughfare of the Market Street Extension, plans for the improvement of which are being drawn up.

Special Treatment Improvements: Caine Avenue from Lakeview Avenue to Ridge Lane, **Havens Street** from Leavenworth Street westerly, and **Vulcan Street** from Lower Terrace to Ord Street, are special treatment improvements for which plans were prepared and proceedings started.

Diagonal Street in Potrero Hills: Plans have been developed for a low grade diagonal street in the Potrero Hill section, connecting Rhode Island Street to Carolina Street between Twentieth and Twenty-second Streets. The grades of the present connecting streets in this vicinity, Nineteenth, Twentieth and Twenty-second Streets, range between 19% and 37%—grades which are prohibitive to heavy traffic and almost inaccessible for fire protection equipment. To carry out the proposed plan of a 60-foot thoroughfare with a grade of 3½% and including acquisition of property and payment of damages, will cost approximately $100,000.

STREET WORK PERFORMED UNDER CONTRACTS

July 1, 1922—June 30, 1923.

	Quantity	Cost
Asphalt Pavement, 6" concrete base		
Wearing surface 2"	55 sq. yds.	$ 139.64
Asphaltic Concrete Pavement, 6" concrete base		
Wearing surface 1½", paint coat	255,816 "	642,463.86
Asphaltic Concrete Pavement, with vitrified brick strip, 6" concrete base		
Wearing surface 1½", paint coat	14,969 "	33,671.73
Vitrified fibre brick	6,681 "	32,071.80
Asphaltic Concrete Pavement		
Wearing surface 1½", minimum(conform)	381 "	360.69
Surface on Viaduct	7 tons	72.00
Asphaltic Binder Fill	6,042 sq. yds.	5,190.57
Concrete Pavement, 6"	21,306 "	59,705.04
Basalt Block Pavement, asphalt and gravel filler		
On 6" concrete base	470 "	2,453.89
On sand, (conform)	13 "	11.50
Broken Rock Pavement	614 cu. yds.	962.33
Gutter		
Concrete	147 sq. yds.	1,921.18
Vitrified brick	66 "	360.61
Curb		
Granite (new)	92 ft.	197.10
" (reset)	594 "	340.37
" (redressed and reset)	2,180 "	1,744.00
Concrete, armored (new)	120,136 "	130,550.07
" " (reset)	27 "	7.79
" " special 8"	473 "	638.55
Wheel Guards, Concrete	2,712 "	1,337.88
Coping, Concrete	839 "	1,765.47
Headers, Redwood	11,067 "	618.40
Sidewalks		
Artificial Stone	21,600 sq. yds.	39,883.93
6" Reinforced Concrete	1,171 "	3,579.63
Asphalt	101 "	120.92
Grading		
Cut	148,530 cu. yds.	161,988.07
Fill	27,093 "	19,314.97
Pipe Railings	2,197 ft.	8,843.60
Walls, Stairways, etc.		
Retaining walls concrete		27,821.85
Rubble walls, mortared	6,381 cu. yds.	48,019.48
" " dry	450 "	1,801.99
Viaduct, concrete		17,741.71
Parapet, concrete	664 ft.	4,896.20

REPORT

OF THE

BUREAU *of* ENGINEERING

OF THE

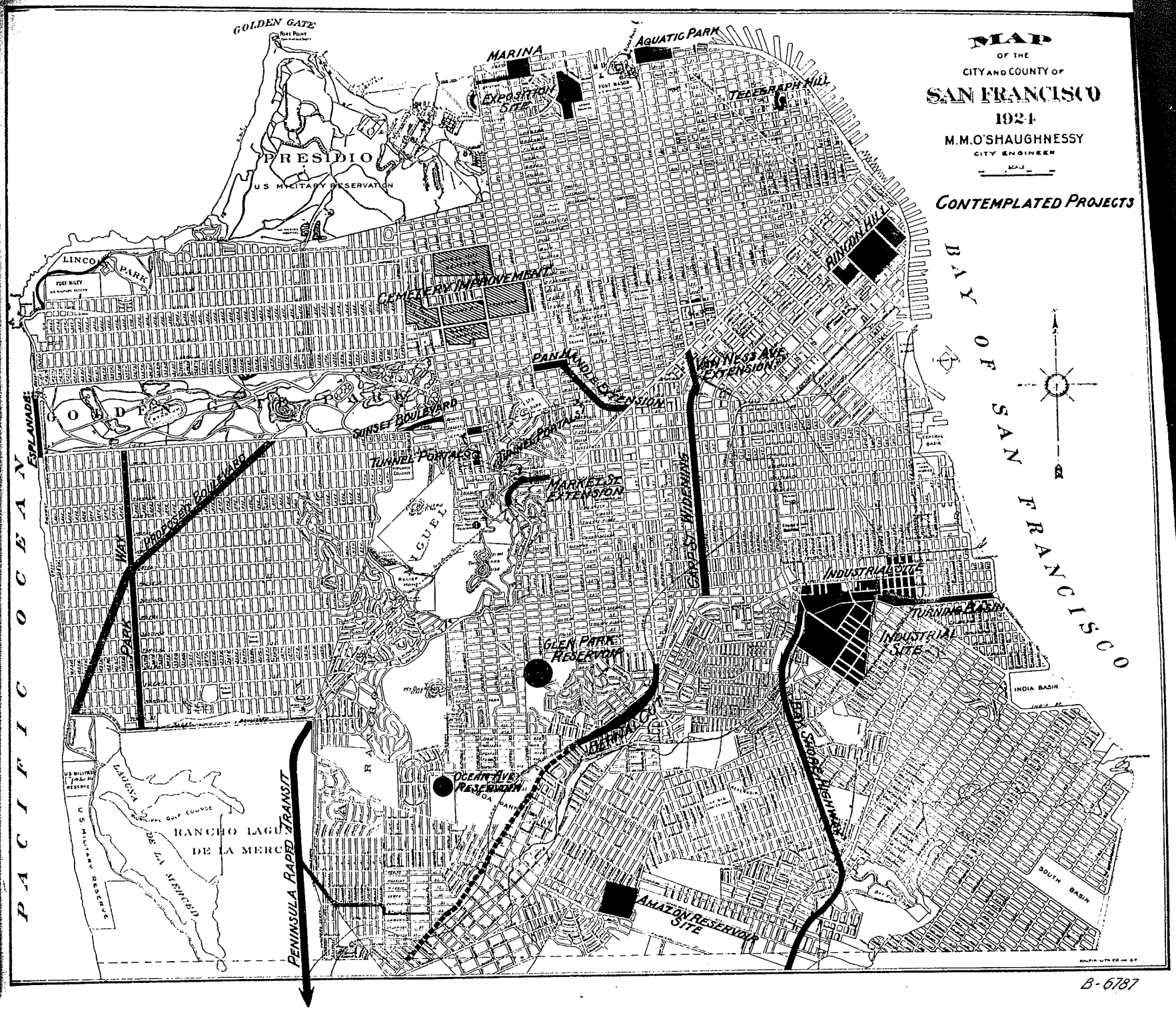
DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF
SAN FRANCISCO

FISCAL YEAR ENDING JUNE 30, 1924

JAMES ROLPH, Jr. - - - *Mayor*

TIMOTHY A. REARDON
DANIEL G. FRASER
CHARLES E. STANTON
Board of Public Works

M. M. O'SHAUGHNESSY
City Engineer


MAP
OF THE
CITY AND COUNTY OF
SAN FRANCISCO
1924
M.M.O'SHAUGHNESSY
CITY ENGINEER
CONTEMPLATED PROJECTS
GOLDEN GATE
MARINA
AQUATIC PARK
EXPOSITION SITE
TELEGRAPH HILL
PRESIDIO
U.S. MILITARY RESERVATION
LINCOLN PARK
FORT MILEY
RINCON HILL
CEMETERY IMPROVEMENT
PAN HANDLE EXTENSION
VAN NESS AVE. EXTENSION
GOLDEN GATE PARK
ESPLANADE
SUNSET BOULEVARD
TUNNEL PORTALS
PROPOSED BOULEVARD
WAY
PARK
MARKET ST. EXTENSION
CARL ST. WIDENING
INDUSTRIAL SITE
TURNING BASIN
INDUSTRIAL SITE
GLEN PARK RESERVOIR
INDIA BASIN
BAY SHORE HIGHWAY
OCEAN AVE. RESERVOIR
LAGUNA
MUNICIPAL GOLF COURSE
RANCHO LAGUNA DE LA MERCED
U.S. MILITARY RESERVE
PENINSULA RAPID TRANSIT
AMAZON RESERVOIR SITE
SOUTH BASIN
PACIFIC OCEAN
BAY OF SAN FRANCISCO
B-6787

The statistical features of this report are embodied in the following table:

Mission-Sunset Tunnel

Length of tunnel—portal to portal	1,634 feet
" " " —over approaches	1,953 "
Height of tunnel	19 "
Width of tunnel	46 "
Width of roadway	40 "
Width of walk	6 "
Grade of tunnel and approaches	2.45%
Area Westerly District (approximate)	1,121 acres
Area Easterly District "	434 acres
Area Total District	1,555 acres
Number of parcels in Mission District	6364
Number of parcels in Sunset District	9367
Total number of parcels	15,731
Number of blocks	550
Cost	$1,572,654.41
City's Share	393,163.60
Balance to assess	1,179,190.81
Maximum rate per square foot (approximate)	.03+
Minimum rate per square foot "	.00+
Maximum assessment 25x100 lot (approximate)	93.75
Minimum assessment 25x100 lot "	15.65
Time to complete	500 days

Consideration of the districts laid out and hearings of protests are being held by the Board of Supervisors.

Rincon Hill Regrade:

Rincon Hill Regrade project is rapidly approaching the actual construction stage. As described in the previous report, a syndicate has been suggested by the Chamber of Commerce to acquire the property and proceed with the regrading, and the following alternative propositions have been offered the owners of property in the Rincon Hill Regrade district:

A. To become shareholders in the syndicate, receiving an interest therein equivalent to their holdings.

B. Selling their holdings to the syndicate.

C. Taking down their own property independently, but in accord with the general project.

Options have been secured or agreement of owners to grade given on 60 per cent of the affected area.

Van Ness Avenue Extension:

The extension of Van Ness Avenue southerly from Market Street to 13th and Howard Streets is also well on the way to completion. A report was prepared and submitted to the Board of Supervisors who, on April 7, 1924, passed a resolution of intention to order the extension in accordance with this report. This report and the resolution of intention set out the boundaries of the district to be benefited and to be assessed for the costs of the extension.

Hearings on this scheme were set for various dates but no further action was taken, as the Board of Supervisors later agreed to the purchase, at this time, of property one block deep to Mission Street, paying for the same over a ten-year period and thus eliminating the assessment district. The costs of grading and paving will be borne by the properties fronting on the new street.

Islais Creek Reclamation District:

The reclamation of the lowlands in the Islais Creek drainage area for industrial sites has been under consideration by this office in conjunction with the San Francisco Chamber of Commerce. At this time the area being directly considered, approximately 277.5 acres, lies between San Bruno Avenue, Oakdale Avenue, Southern Pacific Trestle, Islais Creek, Third, Twenty-fifth, Iowa, and Army Streets. It is proposed to apply to the State Legislature for an enabling act authorizing the formation of a reclamation district to be assessed for the cost of this work.

The following are the main items involved in the construction:

Dredging Islais Creek Channel from the line of Selby Street to the outlet in San Francisco Bay, 200 feet in width, 37 feet below City datum.

A quay wall on the north bank of Islais Creek from Selby Street easterly, approximately 2000 feet in length.

A temporary wood box sewer along the existing channel, approximately 3400 feet in length.

Filling in and reclaiming 8,383,000 square feet, or 192.2 acres, of land.

Ingleside Heights:

The Ingleside Heights project is a similar one to the recently accomplished realignment of streets and resubdivision of Golden Gate Heights, but offers more difficulties in that some of the property affected is already improved. Although but slightly larger in area, the number of parcels involved is much greater.

	Golden Gate Heights	Ingleside Heights
Area	115 acres	122 acres
Parcels	194	1500
Owners	147	596

Tentative reassignments of lots are now being submitted to the property owners for approval. When 90 per cent of favorable requests are received, further action by this office will be taken.

Capp Street Widening:

Preliminary studies have been made for widening Capp Street from the proposed Van Ness Avenue Extension to Army Street as a connecting link to the Bernal Cut, thus affording a direct low grade thoroughfare through the center of the City from the bay shore on the north to the County line, and also relieving Mission and Valencia Streets from much of the heavy vehicular traffic. Capp Street, as proposed, would be widened to 305 feet, allowing for two 80-foot roadways with a maximum grade of 2½ per cent and with an elevated railway in the center. The length of this improvement is 8600 feet. The cost of the necessary lands is estimated at $6,000,000.

Bernal Cut:

The Bernal Cut Improvement has been before this department since before 1913 when, in granting a new franchise to the Southern Pacific Railway Company, it was stipulated that the City be granted a right of way through the existing Bernal railway cut. The necessary grading to accommodate a paved roadway was also made an obligation of the railroad company. The proposed plan provides a clear width of 117 feet 6 inches at the bottom of the cut, allowing for a 42-foot roadway, a double track street railway line, a double track interurban line of the Southern Pacific Company and an eight-foot sidewalk. The cost of this improvement is now estimated at $1,000,000, being $450,000 for property and $550,000 for the improvement, exclusive of the grading to be done by the railroad company. This estimate is almost double the original estimate due to the increased cost of labor and material. It is hoped that there will be no further delay in appropriating the funds for this work.

Park Panhandle Extension:

The extension of the Park Panhandle on a natural water grade from Baker Street easterly three blocks, thence southeasterly to Market Street at Dolores Street, will eliminate much of the cross traffic danger and many of the right angle turns on the present zig-zag route from the Mission into Golden Gate Park. In addition to its esthetic value as a parkway, its value as a fire barrier will be significant. The proposed extension will be 4600 feet in length with a maximum grade of four per cent. The 200 foot width planned will allow of a 46-foot boulevard, two 27-foot commercial roadways, 10-foot walks and 80 feet of park. The value of the necessary lands and buildings on the same is now approximately $3,000,000. Several large improvements are planned by property owners in the line of this extension, and therefore further delay in providing funds for the purchase of the property will greatly increase the cost of the project.

Sunset Boulevard:

Another roadway projected would run through Golden Gate Park from Stanyan and Waller Streets along the northerly side of the new stadium to Lincoln Way and 2nd Avenue, providing a cut-off to the Sunset District. This roadway would be 100 feet in width and approximately 2000 feet in length.

Diagonal Boulevard and Parkways in Sunset and Richmond Districts:

Studies have been made for a diagonal main artery through the Sunset District and for parkways through the Sunset and Richmond Districts. The diagonal road would start at 19th Avenue and Lincoln Way and run to Sloat Boulevard and Great Highway. The Richmond Parkway as proposed would be from Lincoln Park at 33d Avenue to Golden Gate Park near 31st Avenue; while the Sunset Parkway would extend from Golden Gate Park to Sloat Boulevard between 38th and 39th Avenues. These parkways, 240 feet in width, will serve, in addition to use as traffic routes, as fire barriers in case of conflagration.

Miscellaneous Activities:

The following are a few of the minor activities of this department during the past year:

Preparation of sketches to accompany application to the War Department for permit to construct a bridge over the Golden Gate, and showing routes, grades, profiles and connecting roadways.

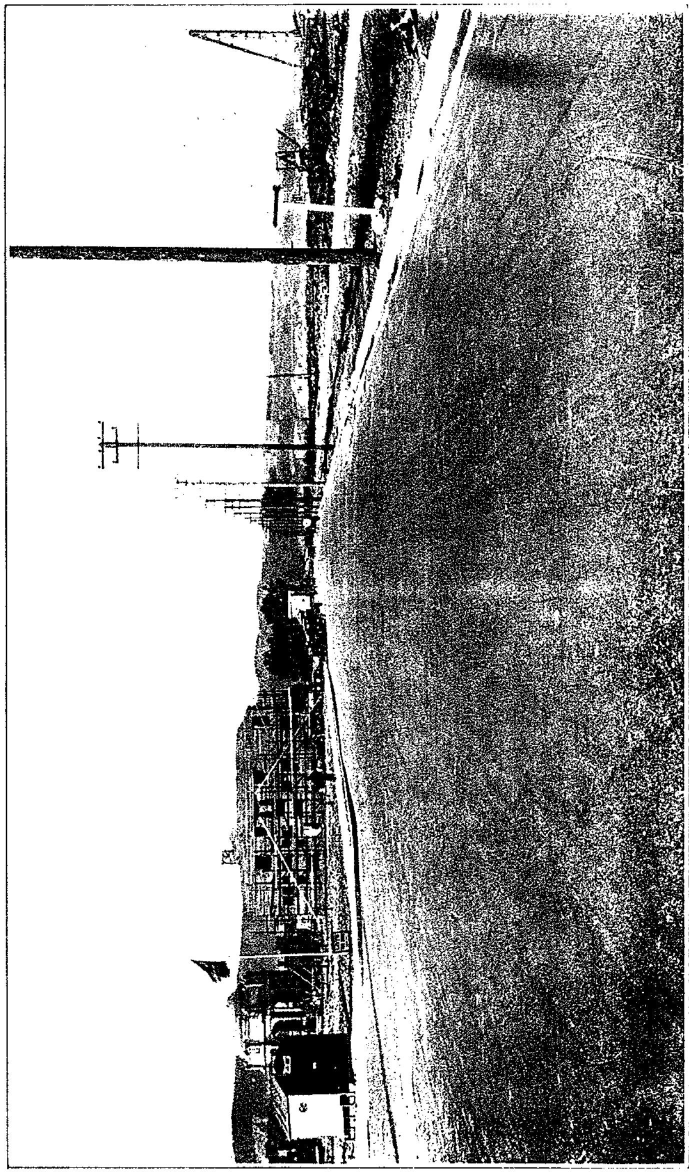
Issued plans and supervised installation of improved weighing device at Municipal Asphalt Plant.

Investigated and reported to the Board of Public Works on the motorization of the Street Cleaning Department, including sweepers, bunkers, etc.

Drew up specifications for motor trucks to be purchased for use of Street Cleaning, Street Repair and Sewer Repair Departments.

WARREN HARDING MEMORIAL (Lincoln Park) BOULEVARD.

Scenic roadway through Municipal Golf Links on top of cliffs of the Golden Gate—recently graded and macadamized.



MARINA BOULEVARD.

Boulevard along the shore of San Francisco Bay from Fort Mason to the Presidio at edge of residential tract.

BOULEVARDS, STREETS AND HIGHWAYS

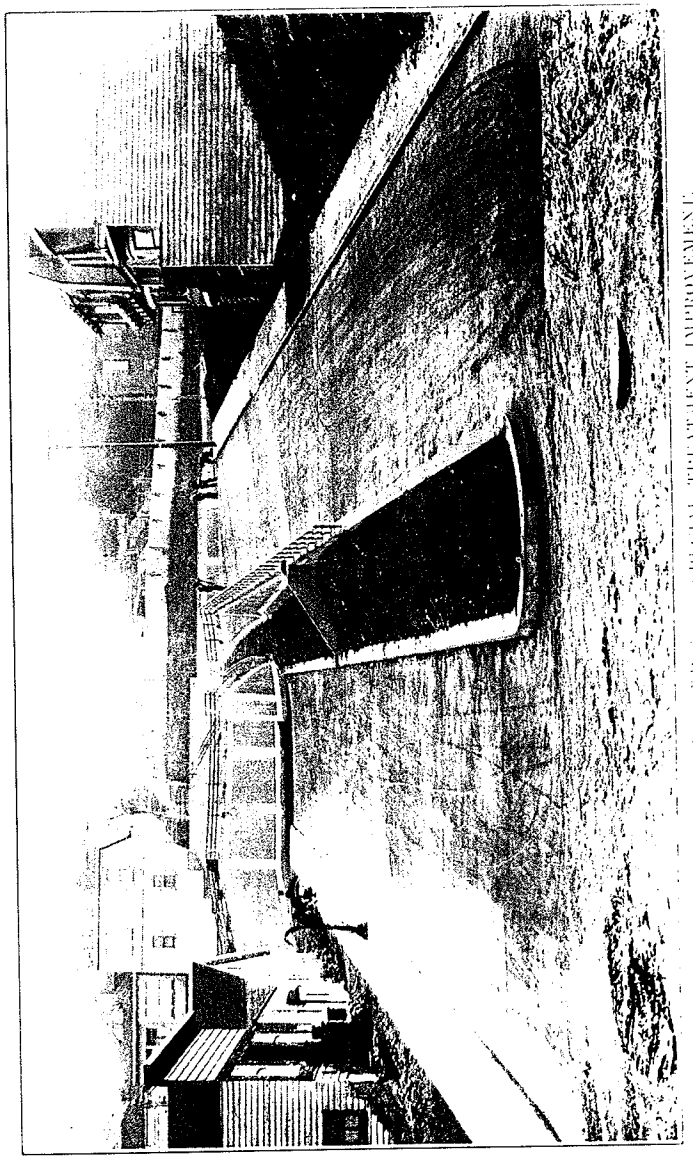
The cost of street improvements completed during the fiscal year under public, private and City pay contracts was approximately $1,458,600. The latter part of this fiscal year has seen the opening of many large residential tracts. These tracts are being improved as a whole and as a result a great amount of street work has been and is now being carried on under private contract permits from the Board of Public Works. Specifications, diagrams, lines and grades, inspection and final quantities are furnished by this department as in all street improvements.

Contracts were under way on the following boulevards:

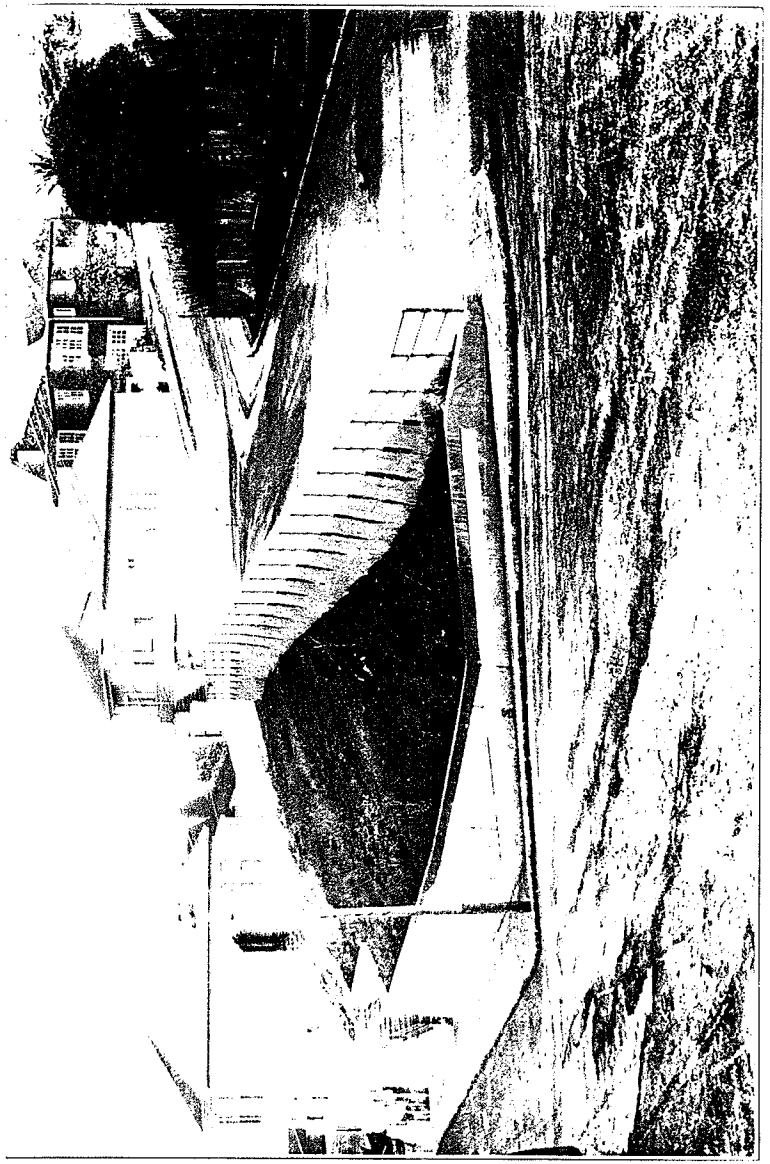
- Lincoln Park Boulevard—grading and macadamizing;
- Telegraph Hill Boulevard—grading;
- Sloat Boulevard and Great Highway Intersection—paving;
- Great Highway opposite Fulton Street—paving;
- Marina Boulevard—paving;
- San Jose Avenue—widening and paving.

Paving was completed on Liberty and Sanchez Streets and is now being placed on Collingwood, Twenty-first and Twenty-second Streets; these being two of the special treatment improvements which were graded during the previous year. Other street improvements of importance completed were:

- North Point Street, Columbus Avenue to Embarcadero—134,100 sq. ft. asphaltic concrete pavement;
- Ulloa Street, Nineteenth Avenue to Twenty-seventh Avenue—125,800 sq. ft. asphaltic concrete pavement;



LIBERTY AND SANCHEZ STREETS SPECIAL TREATMENT IMPROVEMENT.
Retaining walls [illegible] to be made full-side property accessible



LIBERTY AND SANCHEZ STREETS SPECIAL TREATMENT IMPROVEMENT.
Re-alignment of streets to reduce grades.

Twenty-seventh, Twenty-eighth, Twenty-ninth and Thirtieth Avenues, Ulloa Street to Vicente Street—10,000 sq. ft. concrete pavement, 86,000 sq. ft. asphaltic concrete pavement;

Napoleon Street, Jerrold Avenue to Evans Avenue—25,000 cu. yards. fill;

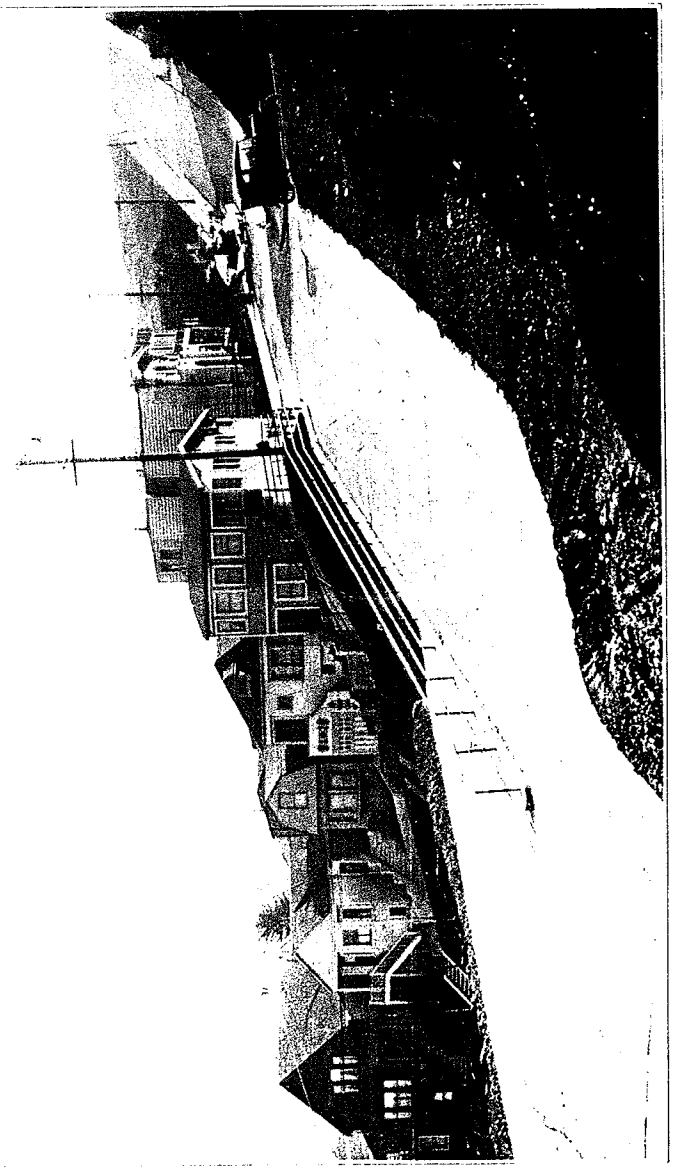
Stulsaft Tract—10,200 cu. yds. cut, 61,500 sq. ft. asphaltic concrete pavement, 2,200 ft. ironstone pipe sewers.

The improvement of Buchanan Street from Hermann Street to Duboce Avenue, involving 33,000 cubic yards of cut and 12,000 square feet of asphaltic concrete and brick pavement is near completion, as is also the laying of 93,000 square feet of concrete and asphaltic concrete pavement on Wilde Avenue from San Bruno Avenue to Delta Street. In addition thereto, large amounts of pavement are being laid in the Marina-Vanderbilt, Marina Gardens, Westwood Highlands, and Balboa Terrace Addition tracts. A contract has been let for grading the roadway and paving a 20-foot center strip on Silver Avenue from Merrill Street to Vienna Street, being a length of 4600 feet. Another permanent improvement under way, the paving of Forty-eighth Avenue from Lawton Street to Taraval Street, is over 5300 feet in length.

The reconstruction work of the Bureau of Street Repair, under a budget of $380,000, was done with the cooperation of this office in furnishing lines and grades and working diagrams. Profiles were furnished also for reconstruction work on the tracks of the Market Street Railways in various sections of the City.

Telegraph Hill Boulevard:

The grading of a boulevard, winding to the top of historic Telegraph Hill, has been completed. Beginning at Kearny and Lombard Streets, a 22-foot roadway with a maximum grade of 9 2/3 per cent has been cut in the hill for a length of 1450 feet to a parking circle at the peak of the hill. Over 19,000 cubic yards of rock were



COLLINGWOOD STREET—SPECIAL TREATMENT STREET IMPROVEMENT.
Section of improvement, illustrating reduction of grade by double roadways and terraced walks.

Report of the
Bureau of Engineering
1924-1925

Department of Public Works
City and County of
San Francisco
M. M. O'SHAUGHNESSY
City Engineer

PROJECTS AND INVESTIGATIONS

Many large projects have been initiated during the past years by this department and have been presented for attention of the public This department has therefore set forth in the following letter to the City Planning Commission a list of and data concerning projects which are considered as of immediate necessity:

"June 18, 1925.

City Planning Commission,
City Hall,
San Francisco, Cal.
Gentlemen:—

I transmit herewith a list of projects which I recommend that you include with the request you intend to make to the Board of Supervisors in regard to projects of importance to San Francisco:

1.	Glen Park Reservoir Site—acquisition of balance, 74.51 acres	$ 180,000
2.	Amazon Reservoir—Construction	2,500,000
3.	San Francisco Bayshore Boulevard	1,750,000
4.	Panhandle Extension to Market Street	3,000,000
5.	Bernal Cut	1,400,000
6.	Ocean Shore Right of Way—Widening	180,000
7.	Sutro Mountain Park—75 acres	150,000
8.	Van Ness Avenue Extension	700,000
	Total	$9,860,000

1. Glen Park Reservoir Site—74.51 acres remaining, situated in Stanford Heights just southerly from Twin Peaks, should be acquired at the earliest possible date. This reservoir has a total acreage of 184.3 acres, including streets. Will provide a capacity of 500 million gallons.

2. Amazon Reservoir Construction, lands for which have been practically acquired, is situated in the Amazon tract, close to the County line, is 52.9 acres in extent, and will provide 300 million gallons capacity. The construction of the necessary dam and appurtenances to impound the water should be started at once.

3. San Francisco Bayshore Boulevard extends from Army Street and San Bruno Avenue to the County line, and will be 125 feet wide, 3 miles long. This boulevard will penetrate a portion of the industrial district of San Francisco which is rapidly coming to the front, and the land required for the boulevard should be condemned at as early a date as possible. This boulevard will connect with the Bayshore Boulevard, extending from the County line; and projected to go clear to San Jose under the State Highway program.

4. Panhandle Extension to Market Street will be practically an extension of the existing panhandle of Golden Gate Park from Baker Street easterly and southeasterly to a point close to Dolores and Market Streets. It will be 200 feet wide, 4600 feet long, and will provide a low grade route for vehicular traffic to Golden Gate Park and adjacent districts.

5. Bernal Cut, extending from Dolores St. and San Jose Ave. to San Jose Ave. and Diamond St.—a length of 4200 feet, and a width of 117½ feet at the bottom of the cut. This will provide for a 42-foot roadway, two tracks for the Southern Pacific Company, and two tracks for the Municipal Railway. It will connect with the San Jose Avenue widening project which is under way, and provide another low grade route through the City and down the peninsula.

6. Ocean Shore Right of Way Widening. It is important that, in addition to the right of way received from the Ocean Shore Railway Company—60 feet in width—additional lands be acquired to widen it to 100 feet from San Bruno Avenue to Onondaga Avenue, and 80 feet from Onondaga Avenue to the County line. This will also provide another boulevard with a low rate of grade down the peninsula and into the heart of the city.

7. Sutro Mountain Park, surrounding Mount Sutro, would provide another high level park which could be encircled by a boulevard similar in character to the Twin Peaks Boulevard, providing a magnificent view of the entire City and Bay region.

8. **Van Ness Avenue Extension** should at this time be extended to Howard Street, as values in this district are rapidly increasing, and any delay almost destroys the prospect of a possible extension within reasonable bounds. At this time $130,000 has been provided in the budget for a first payment on lands extending from Market to Mission Street, and I recommend that the entire extension be provided from Market to Howard Street, including the balance of payments necessary on the extension from Market to Mission Street.

All of the above projects are of immediate necessity, but I call your particular attention to the necessity for constructing the Amazon Reservoir, and for the acquisition of lands for the Glen Park Reservoir, number 1 and number 2 in the above list.

I attach hereto map showing the location of the projects listed.

Very truly yours,

(Signed) M. M. O'SHAUGHNESSY,
City Engineer."

Descriptions of most of these desired improvements have been given in previous reports.

The two reservoirs, one in Glen Park and one in the Amazon Tract are important features in the municipal water supply system now being projected by the City. The present distributing reservoirs of the Spring Valley contains 125 million gallons, or consumption for three days' domestic use. I desire storage of one billion gallons in stock at high levels.

Surveys have been made and details are being planned for the section of Bay Shore Boulevard within the City and County of San Francisco. The City has contributed $500,000 toward construction of sections in San

Mateo County, and the grading of 5½ miles between South City and Burlingame is under way.

The following recommendation was made in the budget requests for the ensuing year submitted by this department:

"**Bernal Cut:** A substantial sum should be appropriated towards the Bernal Cut project. The Bernal Cut improvement has been considered by this department since before 1913 when, in granting a new franchise to the Southern Pacific Railway Co., it was stipulated that the City be granted a right of way through the existing Bernal railway cut. The necessary grading to accommodate a paved roadway was also made an obligation of the railroad company. The proposed plan provides a clear width of 117 feet 6 inches at the bottom of the cut, allowing for a 42-foot roadway, a double track street railway line, a double track interurban line of the Southern Pacific Company, and an eight-foot sidewalk. The cost of this improvement is now estimated at $1,400,000, being $550,000 for property and $850,000 for the improvement, exclusive of the grading to be done by the railroad company. This estimate is about double the original estimate due to the increased costs of property, labor, and material. It is hoped that there will be no further delay in appropriating the funds for this work."

In response to this request, the sum of $100,000 has been allocated in the budget for the ensuing year towards necessary property acquisitions on Bernal Cut project. Plans have gradually been developed for this improvement, special attention having been given to treatment of the various intersecting thoroughfares and also to the general type of structure to bridge the cut.

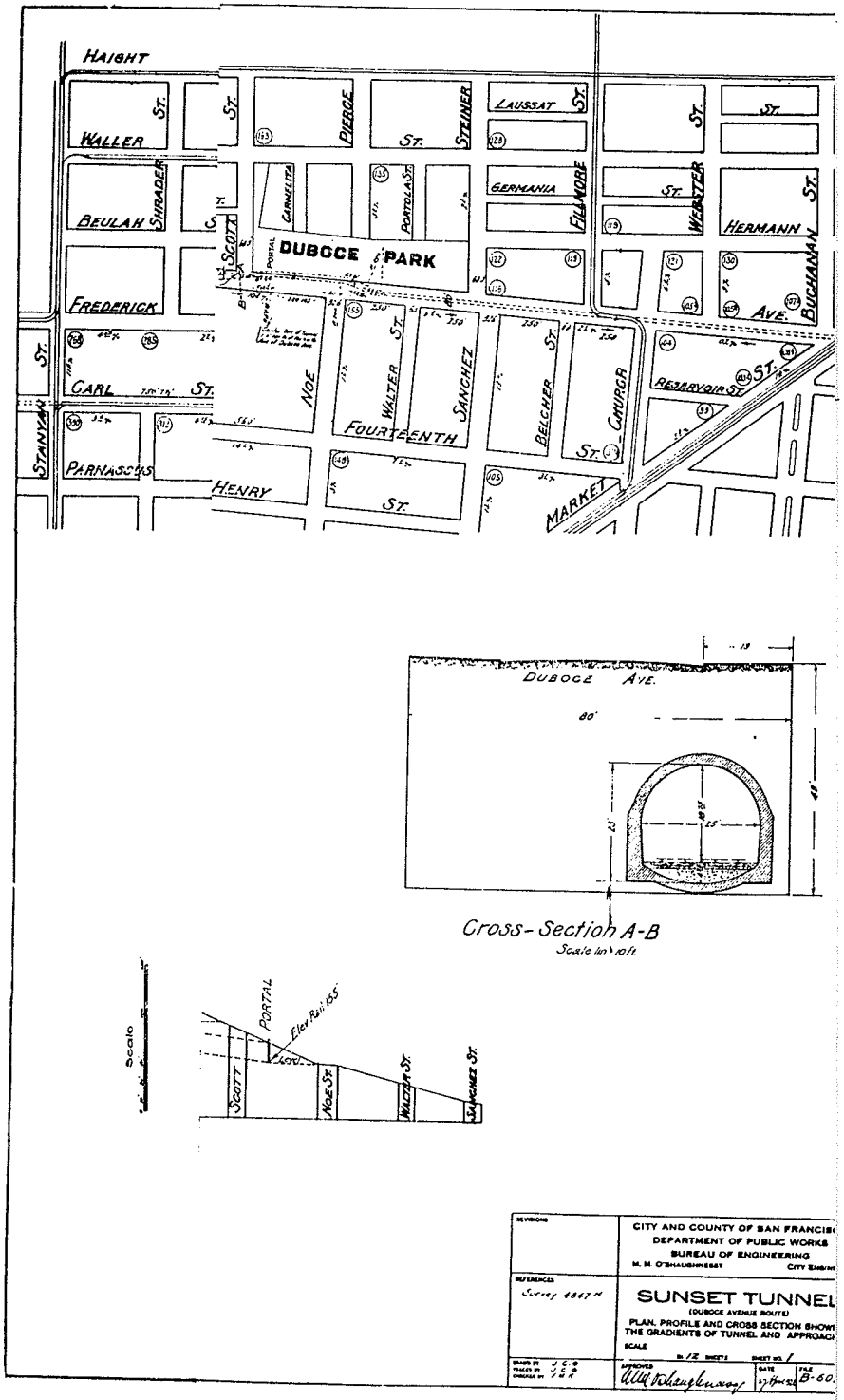
The City has acquired the right of way of the Ocean Shore Railway Company from San Bruno Avenue to the County line. It is planned to construct a boulevard along this strip of land connecting the proposed Bay Shore Boulevard and Junipero Serra Boulevard. As stated in the above letter, additional lands are needed in order to provide sufficient width of roadway. Preliminary studies for connections with the proposed boulevard at San Jose Avenue, Sickles Avenue, Plymouth Avenue and Mission Street are being made.

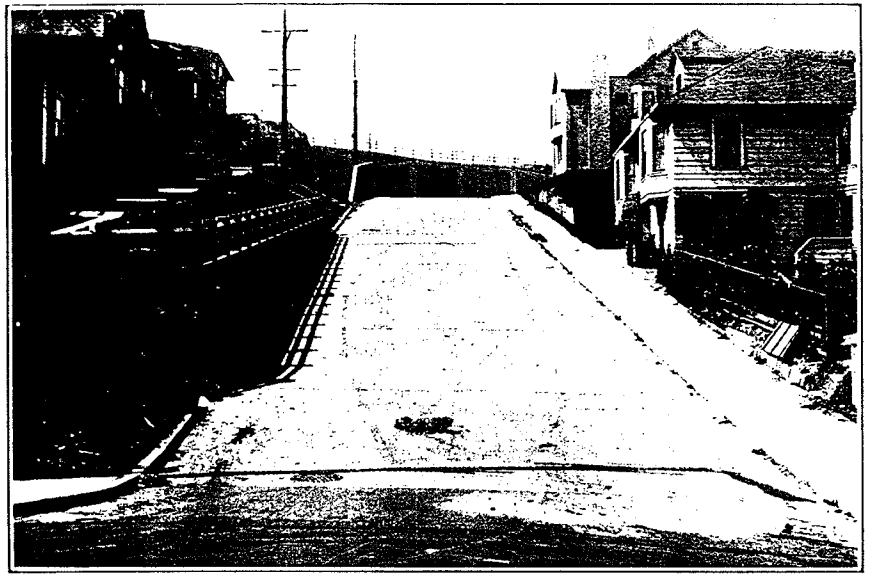
The necessary lands for the extension of Van Ness Avenue to Howard Street will be acquired with the monies allowed in the annual budgets of the City; the sum of $130,000 is included in the budget under consideration for this coming year. This sum will cover one-third of the cost of the land for the first block from Market Street to Mission Street, negotiations now being under way for this purchase to be paid for in annual installments. The cost of improving the street will be borne by the property directly fronting thereon.

Sunset Tunnel:

The Duboce Avenue Route recommended by this office was approved on April 6, 1925, by the Board of Supervisors after protracted political discussion.

A suit filed by antagonists of this project to restrain the City from proceeding has been decided in favor of the City. No doubt, as usual in such public improvements, an appeal will be taken by the obstructionists.





Twenty-first Street, from Castro Street to Collingwood Street.

Twenty-second Street, from Castro Street to Collingwood Street

COLLINGWOOD, TWENTY-FIRST AND TWENTY-SECOND STREETS SPECIAL TREATMENT IMPROVEMENT.

Complete plans and specifications have been prepared and are ready for approval of the Board of Public Works under regular street improvement procedure.

Another large project being developed is the improvement of **Grand View Avenue** for its full length, involving considerable retaining wall work and estimated to cost $130,000.

Liberal aid has been given by the City towards several local district improvements requiring special treatment, where the cost of the work, if assessed to private property, would be confiscatory. The Board of Supervisors has already pledged the City for half the cost of grading and paving of **Douglass Street between Twentieth and Twenty-first Streets**, and necessary plans for this special treatment are ready. Proceedings leading to a contract for this work will be inaugurated provided the sum of $21,500 for the City's share is allowed in the budget.

Other special treatment improvements, either under way or being prepared during the year, were:

Havens Street, Leavenworth Street to westerly termination.
Vulcan Street, Ord Street to Levant Street.
Chestnut Street, Polk Street to Larkin Street.
Coso Avenue, Prospect Avenue to Winfield Street.
Detroit Street, Monterey Boulevard to Joost Avenue.
Elk Street, Bosworth Street to Glen Avenue.
Vallejo Street, Mason Street to Taylor Street.
Vermont Street, Twentieth Street to Twenty-second Street, and **Twenty-first Street,** Vermont Street to Kansas Street.
La Salle Avenue, Lane Street to Mendell Street.

Paving was placed on **Collingwood, Twenty-first and Twenty-second Streets,** thus completing this special treatment improvement, the grading and walls having been done under a previous contract.

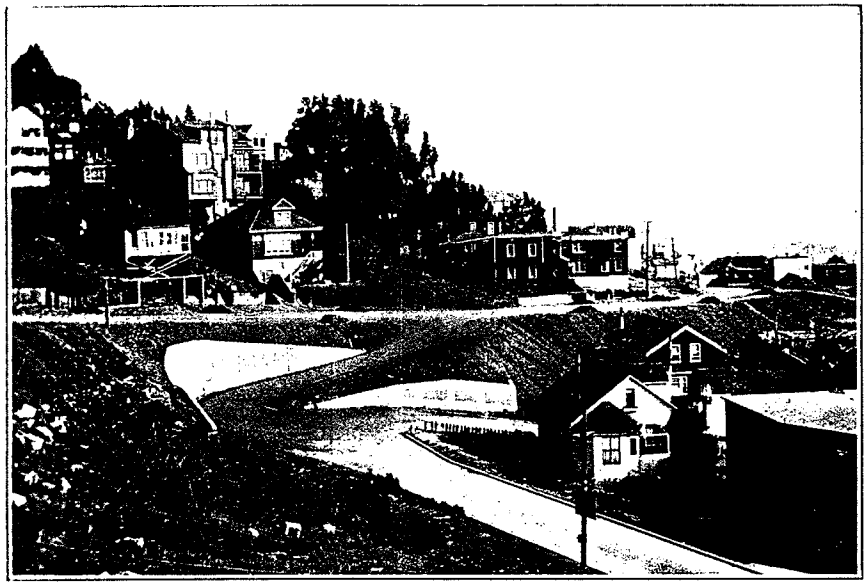
Civic Center Improvement:

Plans and specifications for improvement of the Civic Center park with a specially designed brick and granite pavement on a concrete base were prepared by this department for the Bureau of Architecture. The concrete base and necessary sewers and drainage facilities have been constructed in accordance with these plans.

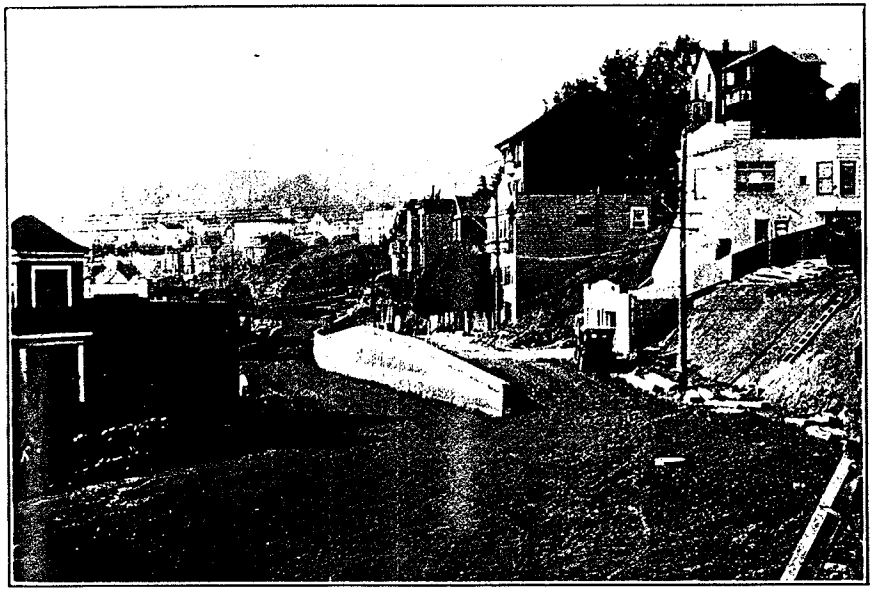
The purchase of additional property for the Civic Center at Fulton and Market Streets permitted the paving of the intersection of Fulton, Leavenworth and Market Streets to be completed. At present Leavenworth Street does not run to Fulton Street but will be extended when the necessary property is purchased. A pavement has been laid over a temporary route from the end of Leavenworth Street through Civic Center property.

Roosevelt Way:

The grading and construction of walls and sewers on Roosevelt Way from Fourteenth Street to Clayton Street is proceeding under a



General view of road, showing side walls and ramp connection with Levant and States Streets



Retaining wall and double roadway serving upper and lower elevations on side hill. ROOSEVELT WAY.

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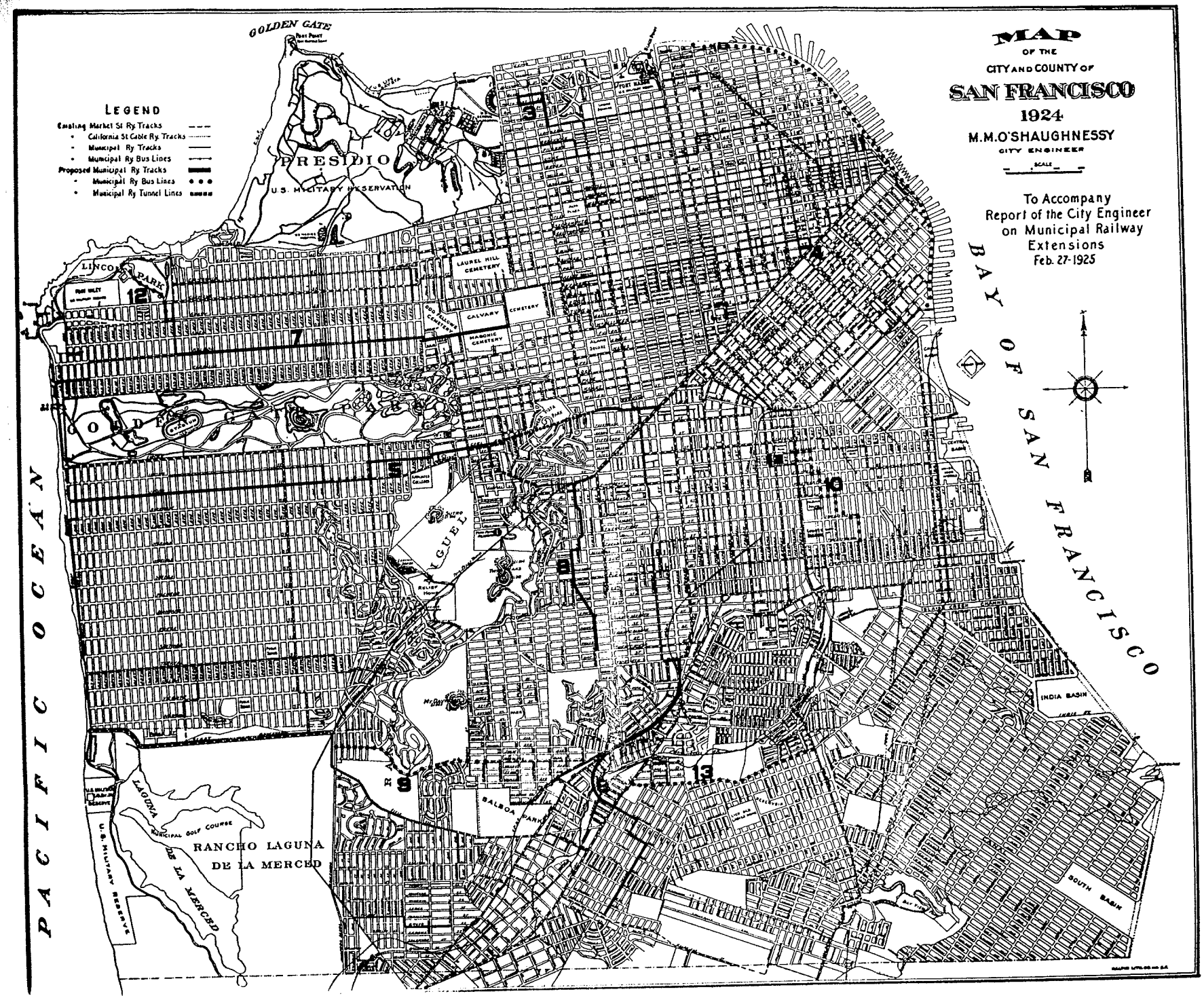

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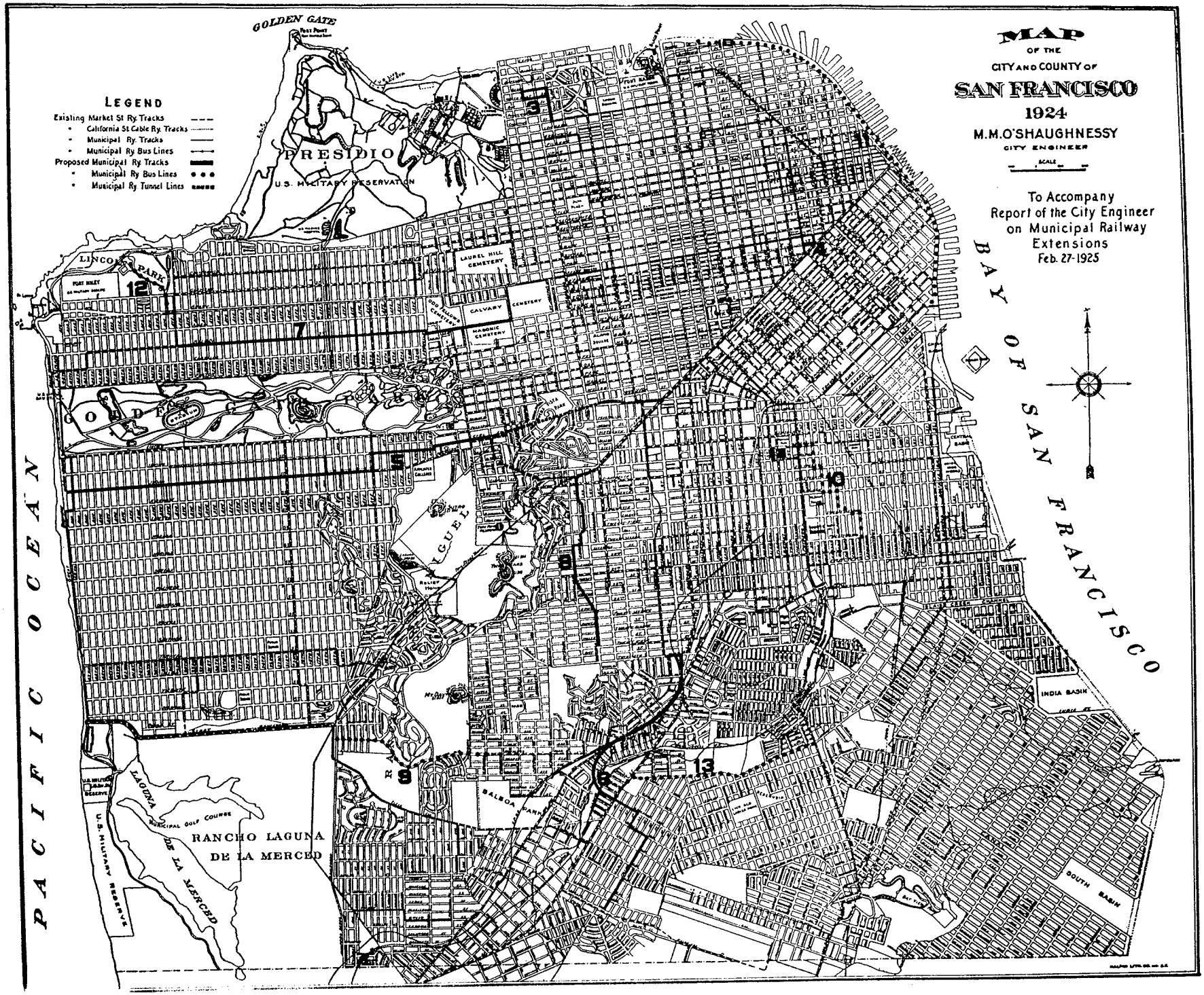

REPORT

OF THE

BUREAU *of* ENGINEERING

OF THE

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF
SAN FRANCISCO

FISCAL YEAR ENDING JUNE 30, 1926

JAMES ROLPH, Jr. . . . *Mayor*

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Board of Public Works

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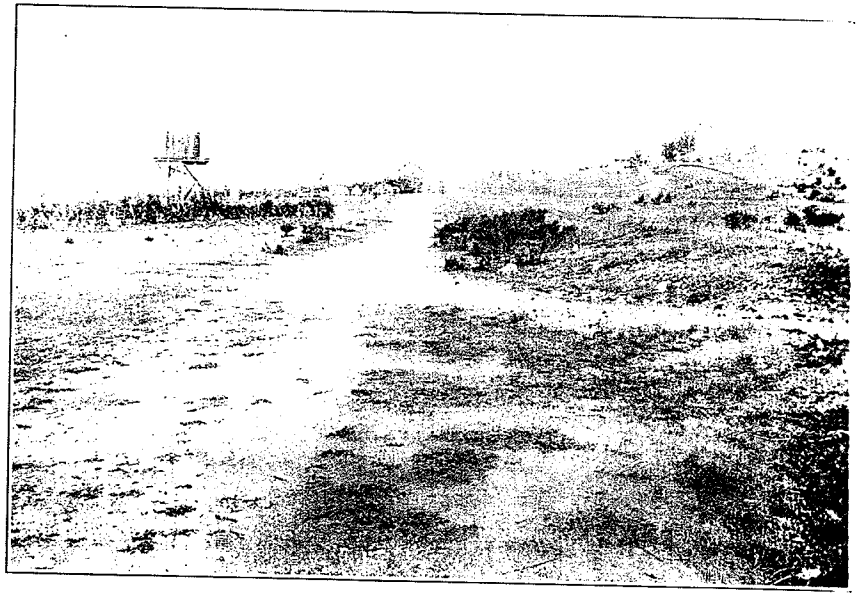
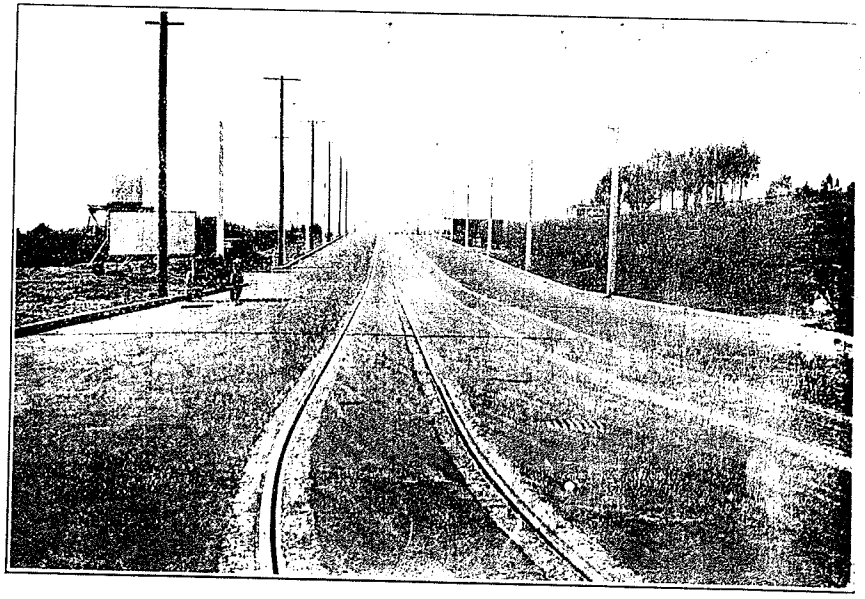
City Engineer



WORCESTER AVENUE
Before and after improvement of street and construction of Municipal Railway Line



BOULEVARDS, STREETS AND HIGHWAYS.

The fiscal year 1925-1926 embraced one of the most intensive construction periods in the City's history; particularly is this true as regards street improvements. This Department handled under public, private and [illegible] contracts, street improvements totaling in cost over $2,400,000, representing an increase of 20% over the cost of work performed in the previous year. In addition, surveys and diagrams were furnished for resurfacing work of the Bureau of Street Repair amounting to $742,450.

The center of street improvement activities shifted to the southwesterly section of the City, viz., the Sunset District, the City Land Association and Ocean View Tracts, and new residential districts west of Twin Peaks. Over one-third of the street work completed was in these districts.

One of the largest and most important street improvements of the year was that of Judah Street from 31st to 41st Avenues, which comprised the paving of this street throughout its entire length. In connection with the paving of the street, rails were laid in this section for Municipal Railway extension to be completed and operated upon completion of the Sunset Tunnel.

Another important street improvement completed was the Worcester Avenue, Randolph Street and Orizaba Street improvement, which provided a completely paved thoroughfare from Junipero Serra Boulevard through the City Land Association and Ocean View Tracts. The Ocean View Extension of the Municipal Railways was recently completed along this route.

The paving of the extension of Van Ness Avenue from Market Street to Mission Street was of importance as it initiated direct communication between Van Ness Avenue and south of Market street. Traffic conditions at the intersections of Market Street with Van Ness Avenue and with 11th Street have been benefited by this improvement.

A contract has been awarded and construction started on the paving of Fillmore Street from Cervantes Boulevard to Marina Boulevard, which street has been widened in this section to a width of 120 feet to provide a 80-foot roadway. As the property owners gave the necessary land for the widening, the City is bearing the cost of the improvement.

Special Treatment Improvements:

Street improvements involving special treatment walls, steps, [illegible] roadways, etc. have received considerable attention from this Department during the past year. Among such improvements under construction or for which plans were being prepared during this period were:

Saturn Street, Ord Street to Lower Terrace.
Vallejo Street, Mason Street to Taylor Street.
Douglas Street, 20th Street to 21st Street.
Vermont Street, 20th Street to 22nd Street.

Street Work Performed Under Contracts—(Concluded).

	Quantity	Cost
Culverts:		
10" Ironstone Pipe	10,213 lin ft.	$21,9[illegible]
10" Ironstone Pipe in concrete	172 lin. ft.	5[illegible]
Miscellaneous:		
Miscellaneous Grading, Drainage, etc.		5,[illegible]
Total Costs		$2,424.32[illegible]

Summary—Cost of Street Work:

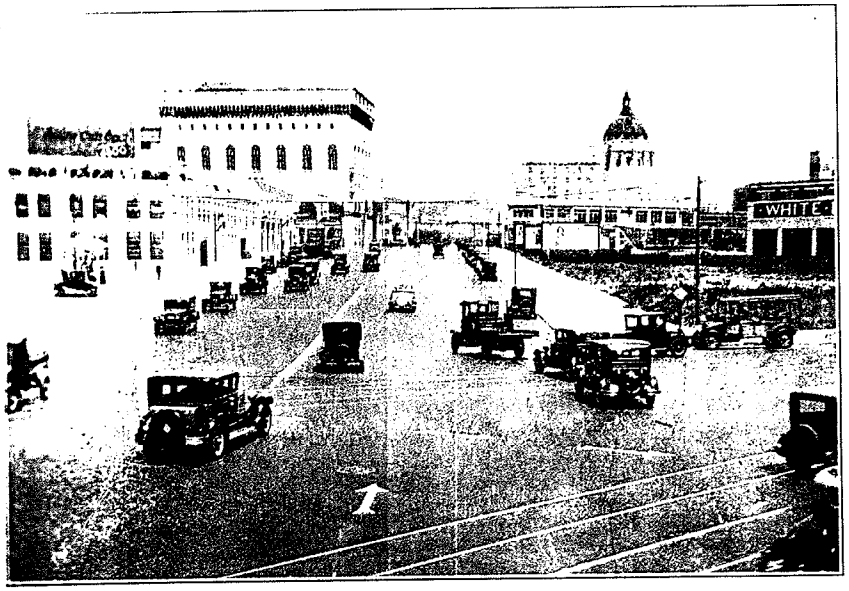
Work under public contracts	$ 314.0[illegible]
Work under private contracts	1,875.7[illegible]
Work under City pay	234.5[illegible]
Total	$2,424.32[illegible]

MAJOR PROJECTS AND INVESTIGATIONS

Bernal Cut:

An appropriation of $100,000 was made available for acquisition of additional property necessary for the Bernal Cut improvement. Of this amount, $25,000 has been spent up to the end of the fiscal year and negotiations are under way with other property owners which will soon complete this appropriation. The total cost of the necessary lands is estimated at $550,000. An additional sum of $135,000 has been allocated for this work during the ensuing year. Descriptions and plats have been prepared for all parcels required and detailed plans of structure bridging the cut at intersecting thoroughfares are being prepared.

The Bernal Cut improvement is an integral artery of the proposed cross-town thoroughfare, embracing Van Ness Avenue, Capp Street, Bernal Cut Boulevard and San Jose Avenue, connecting to the south with the Peninsular Highway. With the widening of San Jose Avenue progressing steadily and the completion of the San Jose Avenue Bridge at Mount Vernon Avenue (as described elsewhere in this and previous reports), the activities of this office will concentrate on the Bernal Cut section of this development.



VAN NESS AVENUE, MARKET STREET TO MISSION STREET

Capp Street Widening:

The proposed widening of Capp Street to a width of 305 feet from Van Ness Avenue Extension to Army Street as a link in a direct low

grade thoroughfare and fire guard through the center of the City has been described in previous reports. Requests have been made by this Department to the Board of Supervisors to promote this project for the near future by prohibiting the construction of Class A and Class B buildings in the street frontage to be acquired which would then have to be purchased and removed.

The following communication bearing on the same subject was addressed to the City Planning Commission on June 10, 1926:

To the Honorable,
City Planning Commission,
City and County of San Francisco.
Gentlemen:

It has been brought to my attention that your Commission has been receiving a number of requests for the rezoning of Capp Street, westerly side, from residential to light commercial or business district.

As you are probably aware, this office has consistently advocated the Capp Street Widening Project, which means the acquisition of a tract of land one lot deep on each side of Capp Street from Van Ness Avenue extended to Army Street.

You are probably already familiar with the details of this proposed improvement, also its function as a transportation facility in connection with the development of our City, the Peninsula, and the Mission District. It involves an approximate length of 8,600 feet, and no grade thereon exceeding 2½ per cent.

It is proposed to reserve within this area a central strip 58 feet in width for a reinforced concrete elevated structure to take care of rapid transit for the Peninsula in the future. It is also proposed to have a two-way traffic artery comprising a 70-foot driveway on each side of this elevated structure in addition to the customary walks and parking areas.

The cost of acquiring residential properties at this time approximates $6,000,000, but this is moderate compared to the estimated cost of $30,000,000 for building a 4-track subway down Market Street from Castro Street to the Ferry.

It is hoped that this Capp Street area will be reserved for the rapidly developing needs of the City's transportation and in order to preserve such an area for this purpose it is imperative that no further business encroachment be made upon this area.

It is also the intent, as needs develop, to bore through the Bernal hills with a tunnel directly south and in line with Capp Street, also to span the Islais Creek section with a viaduct and by following the contours of the lands directly south of the Islais Creek section to tie into both existing and future highways and rapid transit lines. It is also possible, by reaching north of the Capp Street Widening Project at Van Ness Avenue extension, to project further transportation facilities to the down town district.

I recommend, after full consideration by your Commission, that you go definitely on record with a further recommendation from your Commission to the Board of Supervisors as being in favor of this project, so that further conflict on account of zoning requests will be eliminated.

It is not contemplated that this project shall be immediately completed, but rather that we shall be put on record and appropriations be made annually from time to time as may be necessary to prevent its

value lost for all time. The recent conflagration at Ewing Field as well as the experiences in the 1906 disaster demonstrate beyond question the great further value of a fire guard that this project will serve in case of a great conflagration in the wooden section of our City.

I think it would be well also to bear in mind at this time that no immediate expenditure is necessary. Apparently all property owners residing on this thoroughfare are desirous of maintaining their residential status but would not be averse to having their entire frontage taken for boulevard purposes instead of being spotted here and there for both residential and business purposes. Respectfully,

M. M. O'SHAUGHNESSY, City Engineer.

Islais Creek Reclamation:

As previously reported, the Islais Creek Reclamation District, provided for by the State Legislature, April 6, 1925, has been formed. Messrs. Colbert, Caldwell, M. M. O'Shaughnessy and Stuart F. Smith were appointed trustees to serve the district. To test the legality of the Reclamation Act applying to the Islais Creek District, a suit has been instituted by a property owner.

In cooperation with the Chamber of Commerce and the Board of Harbor Commissioners, this office at various times has prepared reports for the proper presentation by the Trustees to the U. S. Government of the needs of the Islais Creek Reclamation District, with special reference to the Government's part in dredging the shoal at the mouth of Islais Creek and the discharge of the dredged materials onto the lands to be reclaimed.

The report presented to the Government by Congressman Richard J. Welch (then Supervisor) at Washington, D. C., in April, 1926, received favorable consideration by the Board of Army Engineers and a recommendation was made to Congress for an appropriation of $146,000 toward the cost of dredging the shoal at the mouth of Islais Creek. With this appropriation the U. S. Government will accomplish the dredging of the flared approach to the Channel and also the shoal southerly therefrom, involving a total of 2,091,000 cubic yards of material at a cost of approximately 7 cents a yard. The Reclamation District will pay the cost of the balance of dredging and assumes all costs of the rubble wall north of Islais Creek Channel, west of Third Street, and of the temporary main sewer.

Surveys of the 280 acres involved in this work are now under way so that a report outlining plans for the proposed work and necessary estimates of costs to start the project may be submitted to the Board of Supervisors without delay.

Bay Shore Boulevard:

Drawing of detail maps of the Bay Shore Boulevard has been under way. Practically all of the necessary lands from Potrero Avenue to Marengo Street have been purchased. Descriptions of all the right of way are being made up so that all needed property may be acquired be-

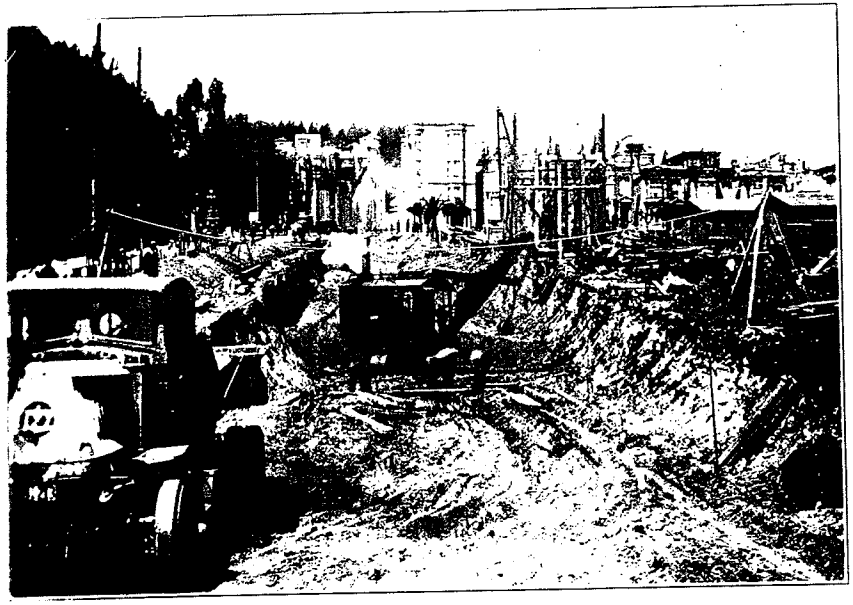
fore buildings are located along the line, as the route traverses a district which is rapidly being taken over by industrial firms. An appropriation of $100,00 made in August, 1925, and the sum of $135,000 to be made available during the coming fiscal year will provide funds to carry on this program. The total appraisal of lands to be acquired is approximately $850,000.

Bids for constructing the undercrossing under the Southern Pacific Railroad tracks at South City in San Mateo County are to be opened July 19, 1926. This structure is estimated to cost $240,000.

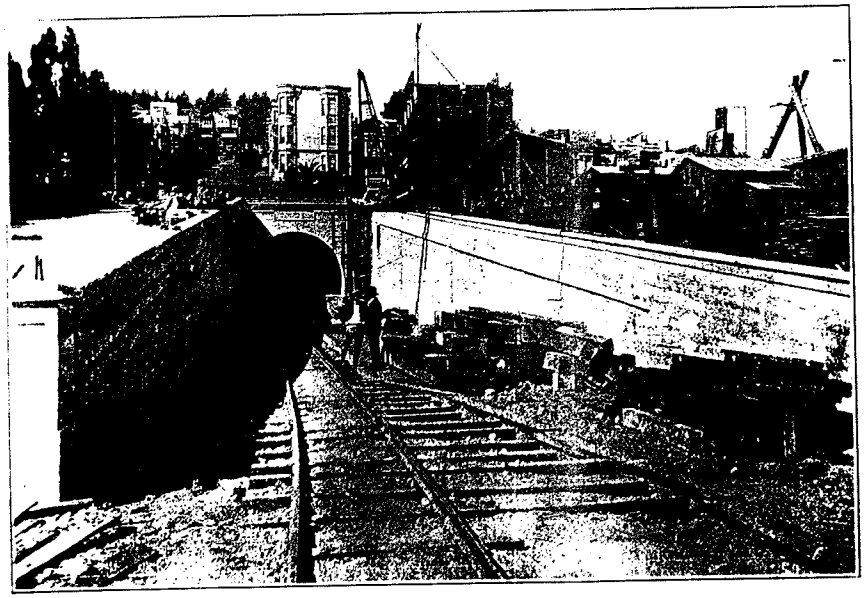
Alemany Boulevard:

The right of way of the defunct Ocean Shore Railroad from San Bruno Avenue southwesterly to the County line was purchased by the City for highway purposes. The original right of way varied in width from 60 to 80 feet and adjoining properties necessary for a 100-foot wide highway are now being acquired. The roadway will be extended on the east to Islais Creek docks and will provide a traffic artery on an average 2%, or less, grade from the industrial district to the potential residential territory south of Lake Merced lands, and will be a cross connection between the Bay Shore Highway, Bernal Cut Boulevard and Junipero Serra Boulevard.

Considerable progress has been made on the plans for this improvement. Survey lines have been run; descriptions of the properties required prepared; grade studies have been completed, and plans and cross sections are being prepared.

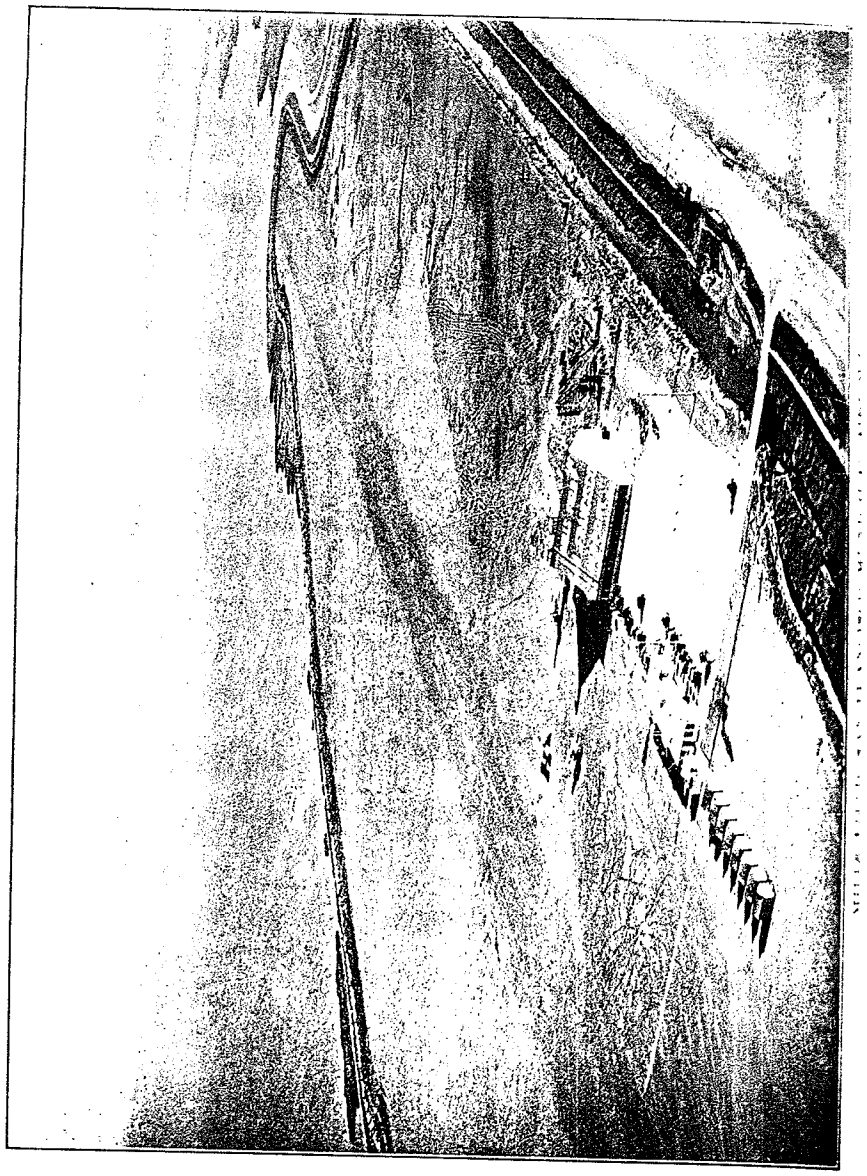


Starting construction—excavation at east portal.



East portal and concrete approach walls.

SUNSET TUNNEL (DUBOCE AVENUE ROUTE)



REPORT

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FISCAL YEAR ENDING JUNE 30, 1927

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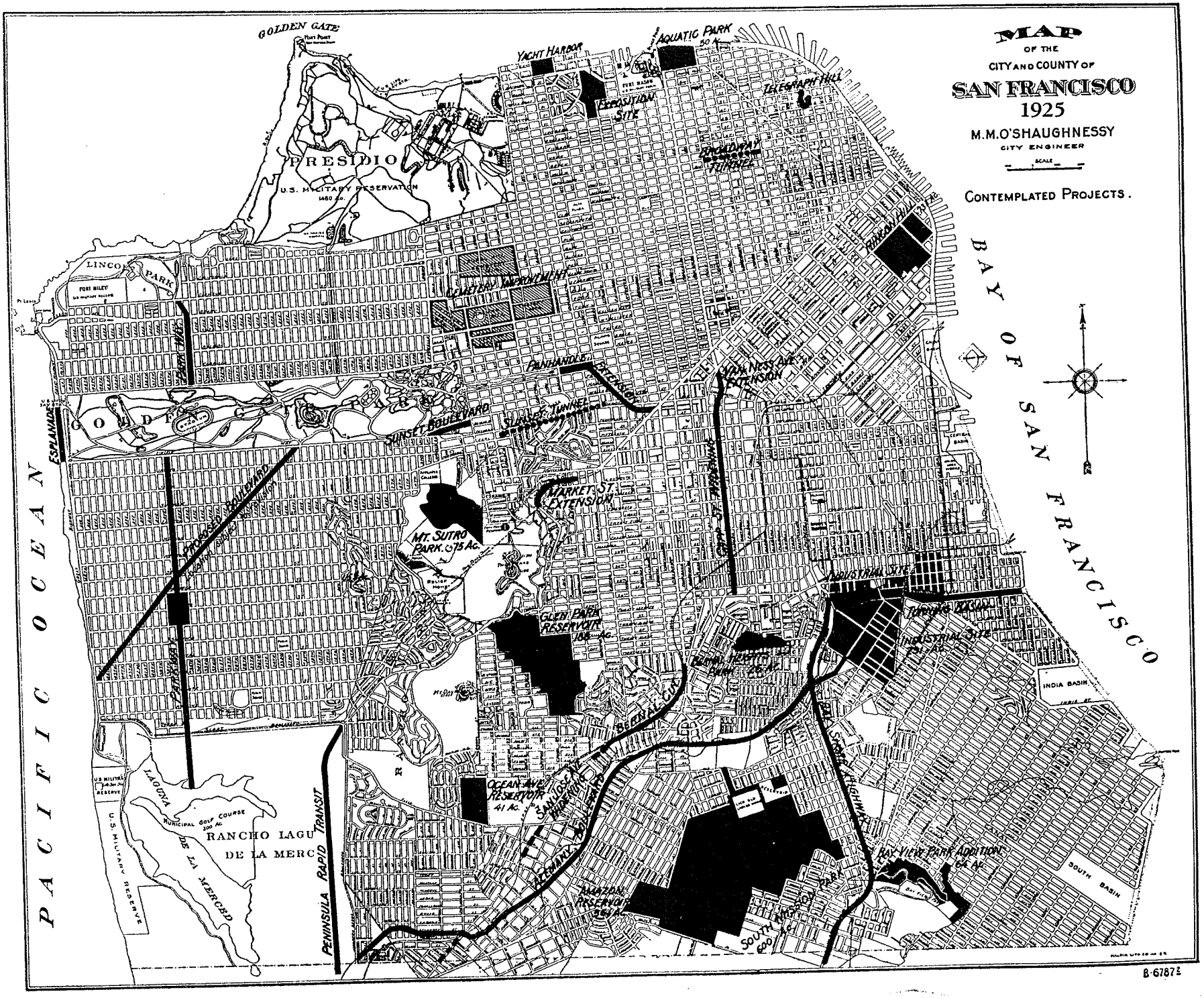

MAP
OF THE
CITY AND COUNTY OF
SAN FRANCISCO
1925
M.M.O'SHAUGHNESSY
CITY ENGINEER
SCALE
CONTEMPLATED PROJECTS.
GOLDEN GATE
YACHT HARBOR
AQUATIC PARK
50 Ac.
EXPOSITION SITE
TELEGRAPH HILL
PRESIDIO
U.S. MILITARY RESERVATION
1480 Ac.
LINCOLN PARK
FORT MILEY
U.S. MILITARY RESERVE
CEMETERY IMPROVEMENT
PARKSIDE
PARNASSUS
EXTENSION
VAN NESS AVE. EXTENSION
GOLDEN GATE PARK
SUNSET BOULEVARD
STANYAN TUNNEL
ESPLANADE
PROPOSED BOULEVARD
MARKET ST. EXTENSION
MT. SUTRO PARK. 175 Ac.
INDUSTRIAL SITE
GLEN PARK RESERVOIR 18 Ac.
TERMINAL EXTENSION
INDUSTRIAL SITE
731 Ac.
INDIA BASIN
BERNAL CUT
OCEAN AVE. RESERVOIR 41 Ac.
SAN JOSE AVE.
BAY SHORE HIGHWAY
LAGUNA DE LA MERCED
MUNICIPAL GOLF COURSE 200 Ac.
RANCHO LAGUNA DE LA MERCED
U.S. MILITARY RESERVE
PENINSULA RAPID TRANSIT
HOLLY PARK RESERVOIR 26 Ac.
BAY VIEW PARK ADDITION 64 Ac.
SOUTH BASIN
SOUTH BASIN PARK
600 Ac.
PACIFIC OCEAN
BAY OF SAN FRANCISCO

B-67872

6) A beach frontage improvement, being an extension of the present concrete **Esplanade** or seawall, running along and upon the Great Highway west of Golden Gate Park from Fulton Street southerly to Lincoln Way.

7) An improvement of the **Great Highway** from Lincoln Way southerly to Sloat Boulevard.

8) The extension of **Van Ness Avenue** from its present southerly termination at Mission and Twelfth Streets southerly to Howard and 13th Streets.

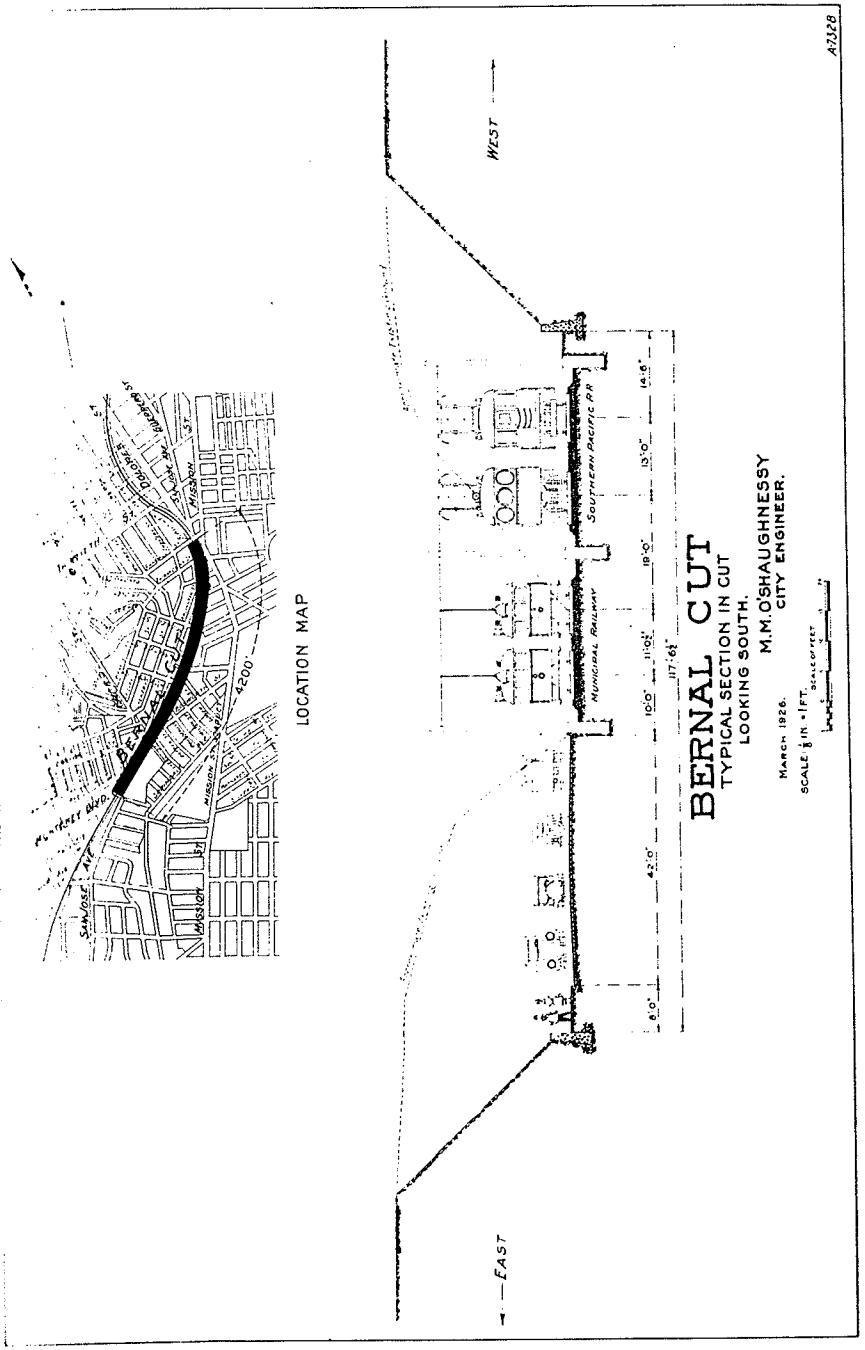
A summary of the above mentioned projects follows:

Name	Length Miles	Width Feet	Estimated Cost
1—Bay Shore Highway	3.01	125	$3,365,000
2—Alemany Boulevard	4.80	100	2,365,000
3—Junipero Serra Boulevard	1.80	125	850,000
4—19th Avenue Extension	1.25	128	500,000
5—Sunset Boulevard	2.10	240	*1,900,000
6—Esplanade, Fulton St. to Lincoln Way	.45	188	475,000
7—Great Highway, Lincoln Way to Sloat Boulevard	2.05	120	525,000
8—Van Ness Avenue Extension	.16	125	*500,000
Total	15.62		$9,380,000

*(For acquisition of necessary properties only.)

The proposed **Bernal Cut** improvement is an integral part of the system of highways planned within the City, and will join Dolores Street with the southerly section of San Jose Avenue, near Monterey Boulevard, thus adding another practical through route from Market Street to the County Line. This improvement, planned for years, is now assured of consummation. At a bond election held on June 14, 1927, the voters authorized the incurring of a bonded indebtedness of $1,400,000 for the acquisition, construction and completion of "A cut, or excavation with approach fills, providing an improved route for public highway purposes . . . known as the Bernal Cut . . . including approaches, structures, pavements, curbs, sidewalks, sewers, drainage facilities, the re-adjustment of intersecting and adjacent streets and other improvements, and the purchase of necessary lands." The vote on the bonds was: For 52,623; Against 17,952.

Prior to the bond election, plans for the work had been prepared in considerably greater detail than is customary. On account of the advanced work on the plans, it was possible to purchase property necessary for the work. With $135,000 made available out of the general fund, 33 per cent of the necessary property was acquired, plans were prepared and borings made to determine the character of the ground to be excavated.



Bernal Cut extends from the junction of Dolores Street and San Jose Avenue southerly to the intersection of Diamond Street and San Jose Avenue near Monterey Boulevard. The improvement will be 4,200 feet long, 117 feet 6 inches wide on the bottom, with slopes in the cut proper of 1½ horizontal to 1 vertical. The bottom width will be apportioned as follows: an 8 ft. sidewalk, a 42 foot vehicular roadway, a right of way for double tracks of the Municipal Railway and a similar right of way on the west side for the Southern Pacific Company, with retaining walls four feet high on either side of the bottom. The railway rights of way will not be paved, but will be fenced off from the vehicular roadway. There will be a sidewalk 6 feet wide constructed on the top of the cut on either side. The present cut of the Southern Pacific Company has a bottom width of 20 feet.

The estimated cost of the project, $1,400,000, is apportioned as follows:

$579,000 for Contract No. 1, $83,400 for Contract No. 2, $18,000 for Contract No. 3, $615,000 to acquire property, $44,600 for engineering, and $60,000 for contingencies.

Contract No. 1 will embrace the following items: 250,000 cubic yards of cut and 50,000 cubic yards of fill; the reconstruction of Randall Street between the Southern Pacific Company's right of way and Chenery Street; the construction of approximately 5,300 lineal feet of masonry retaining wall at the top of slope in the cut; a complete drainage system; a concrete bridge between Richland Avenue and Miguel Street; a concrete bridge extending from the end of Highland Avenue to Arlington Street; the removal of the existing arch bridge, and the construction of a concrete girder bridge at Bosworth Street—estimated cost $250,000. If no delays occur, work will commence on Contract No. 1 by May 16, 1928, and should be completed by September 15, 1929.

Contract No. 2, which will consist of a permanent asphalt pavement in the cut, all curbs in the cut, and a temporary macadam pavement on the fill; walks, coping, and fences; will cost approximately $83,400. Work should commence on this contract about September 30th, 1929, and ought to be completed by the end of January, 1930.

Contract No. 3 will consist of a permanent paving, curbs, walks, coping, and fence, and concrete steps from Bosworth Street to the top of the Bosworth Street Bridge—estimated cost $18,000.

Contract No. 3 should be awarded not sooner than June 30, 1930, so that the fill may have ample time for settlement. If this contract is awarded on June 30, 1930, the entire project should be completed by September 30, 1930.

It will be necessary to remove the existing bridges across the "Cut," i. e., the Charles Street Bridge, and the Richland Avenue-Miguel Street Bridge. The bridges removed will be replaced by reinforced concrete structures, one to be constructed at Highland Avenue and another connecting Richland Avenue and Miguel Street. At Fairmont Street, a small bridge carries the 30-inch riveted wrought iron main leading from San Andres Reservoir to College Hill Reservoir.

SPECIAL PROJECTS AND INVESTIGATIONS

Islais Creek Reclamation:

Work has progressed satisfactorily on plans for the reclamation of the Islais Creek District.

A decision (S. F. case No. 11948) establishing the legality of the District was handed down by the Supreme Court January 21, 1927, in an opinion written by Chief Justice William H. Waste. In accordance with the procedure set forth in the Act of Legislature approved April 6, 1925, the plans were submitted to the Board of State Harbor Commissioners of the State of California and approved by them on May 18, 1927.

The Trustees of the District formally adopted the plans and estimates on May 23, 1927, and filed two copies with the County Clerk on May 26th. On May 27, 1927, they filed plans, certified by the County Clerk, with the Clerk of the Board of Supervisors, with a request that the Board appoint three Assessment Commissioners who shall spread the estimated cost of the work in accordance with the benefits which the individual parcels of land will receive. The appointment of these Commissioners has been referred to the Street and Commercial Development Committee of the Supervisors and is under discussion at this time.

The estimated cost of the project is as follows:

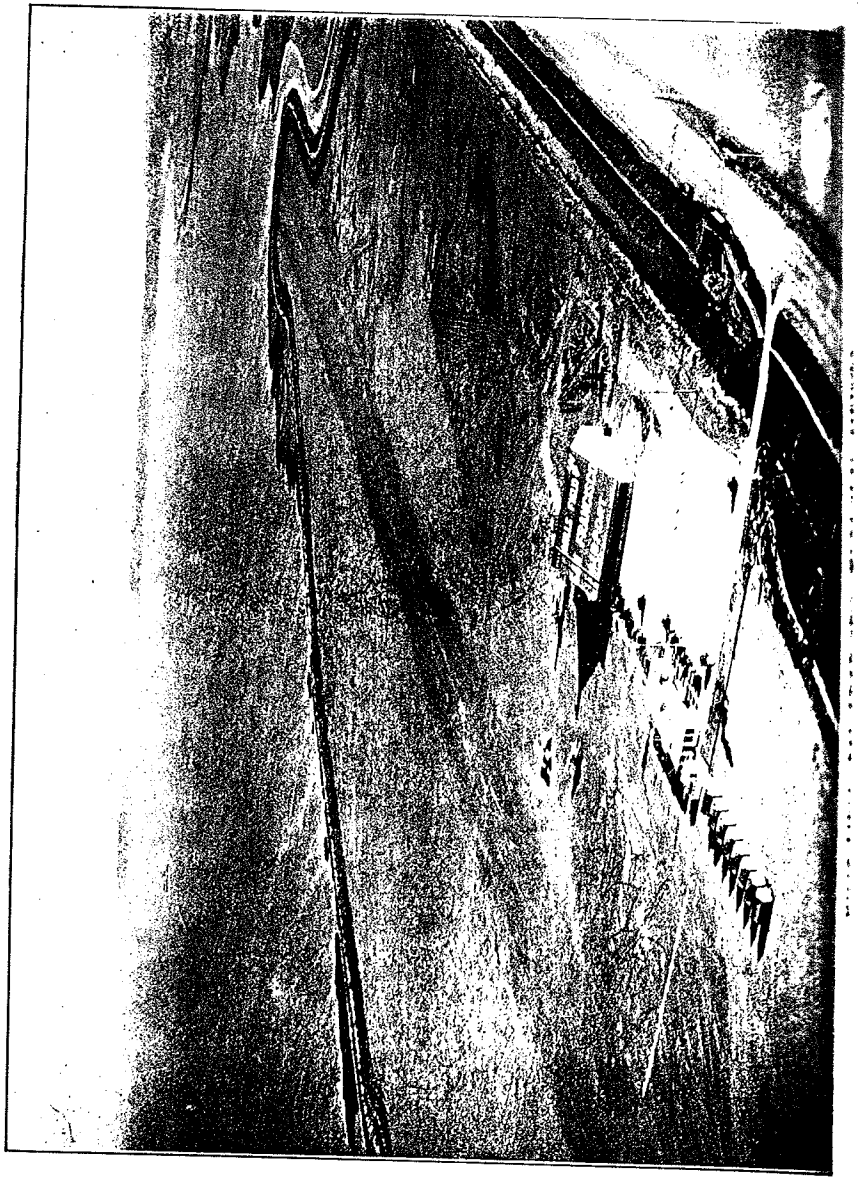
Fill	$ 866,285
Rock bulkhead wall	493,867
Sewer	160.000
Incidentals	50,000
Engineering, Inspection, Collection	50,000
Total	$1,620,152

The 280 acre site was surveyed and a contour map made on a scale of 1 inch equals 40 feet, with 1-foot contour interval. From the contour map, profiles were made so as to obtain the quantities of material for the purpose of estimating costs. Fill was calculated for each lot and each street and crossing.

Bay Bridges:

For many years the subject of a bridge over San Francisco Bay to the east bay cities has been agitated but it is only recently that the necessity for such a bridge has been conceded by practically all interests.

Up to the spring of 1927 eighteen separate applications had been made to the Board of Supervisors for a franchise to construct such a bridge. Right to grant such a franchise is vested in the county on the left bank of the stream descending, but the location is subject to approval by the War Department of the United States at Washington, acting through the military engineers who are in charge of rivers and harbors, and also by the engineer of the State of California.



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Board of Public Works

M. M. O'SHAUGHNESSY
City Engineer

ILLUSTRATIONS AND DIAGRAMS—(Continued)

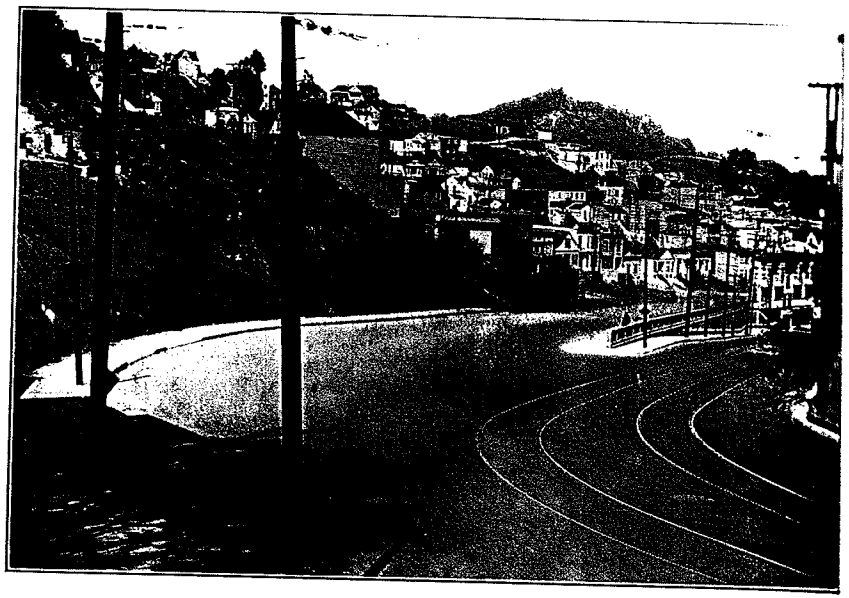
BOULEVARDS, STREETS AND HIGHWAYS

The rapid development of the unsettled residential areas of the City during the past few years created an unprecedented demand for street improvements. The value of the street improvements handled through this Department under public, private and City-pay contracts completed during the fiscal year 1926-1927 was over $3,100,000, representing an increase of 30 per cent over the preceding year and is almost four times the value of similar work done in 1921-1922.

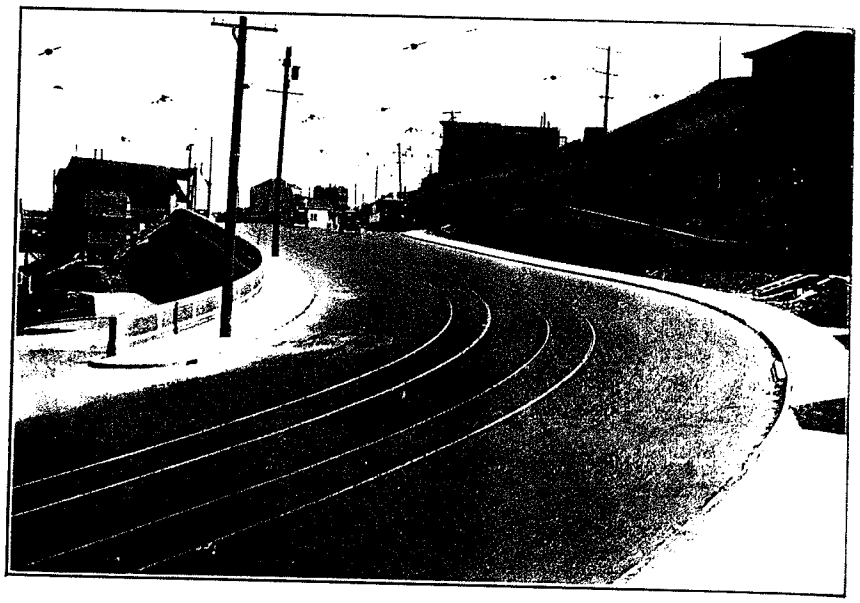
The above figure does not include the large amount of improvements for which plans and diagrams were prepared during the year, or for which proceedings were started, and which is now under way. In addition, surveys and diagrams were furnished for reconstruction work of the Bureau of Street Repair amounting to over $500,000.

Even more so than in the previous year, the major portion of street improvements was in the southerly and southwesterly sections of the City, viz., the Sunset District, City Land Association Tract, University Mound Tract, Bay View Association Tract, and the new residential districts west of Twin Peaks. Rutland Street, Arleta to Harkness Avenues (6 blocks), Woolsey Street, Colby to Somerset Streets and adjacent streets (12 blocks), Schwerin Street, Visitacion Avenue to the County Line (2 blocks), Munich Street from Excelsior to France Avenues (4 blocks), 14th Avenue, Rivera to Vicente (4 blocks), 34th Avenue, Ulloa to Sloat Boulevard (3 blocks), 45th Avenue, Rivera to Sloat Boulevard (6 blocks), Monticello Street, Holloway to Sargent (3 blocks), Byxbee Street, Holloway to Randolph (4 blocks) and Ralston Street, Garfield to Randolph (3 blocks), were some of the larger local street improvements completed. With the completion of the section of the Westerly Sunset sewer along Santiago Street, this street, with the exception of three blocks, was paved between 17th and 33rd Avenues and work on many of the adjacent avenues is under way from Rivera to Santiago Streets, this section being dependent for a drainage outlet on the Santiago Street sewer. Similarly, Kirkham, Lawton, and Moraga Streets, from 23rd to 28th Avenues, and 23rd and 28th Avenues inclusive, from Lawton to Noriega Streets, were paved or are under way as the result of the recent construction of a large section of the Central Sunset District Sewer. Following the paving of Judah Street from 31st to 41st Avenues, most of the avenues adjacent to this section of Judah Street southerly to Kirkham Street were improved or put under way.

Fillmore Street from Cervantes Boulevard to Marina Boulevard, 120 feet in width with an 80 foot roadway, was paved. Bluxome Street, a heavy traffic artery, was reconstructed between 4th and 6th Streets. Southern Heights Avenue, the low grade diagonal street recently put through a portion of the Potrero Hills section, between Carolina and Rhode Island Streets, north of Twenty-second Street, was completed with the paving of the roadway and connecting approach streets. Turk Street from Masonic Avenue to Willard Street is being paved. This street was



MARKET STREET EXTENSION



widened to a minimum width of 88 feet, having a roadway of 68 feet between the curbs; the additional land having been given by the Roman Catholic Archbishop of San Francisco and the Presentation Sisters.

Among the residential tracts being improved with streets, sewers, etc. were Mt. Davidson Manor, Westwood Highlands, Balboa Terrace, Miraloma Park, Geneva Terrace, and Pinelake Park.

Market Street Extension:

A contract was awarded and work on the grading and paving of Market Street Extension from Mono to Ord Street was practically completed. The completion of this section marks the finish of the improvement of this extension, commenced shortly after the completion of Twin Peaks Tunnel in 1918. The extension of Market Street over easy grades from its former termination at Castro Street, partly over the right of way purchased for the easterly section of the tunnel, and partly over existing streets by straightening and widening them, to a connection with Portola Drive, provides a direct route via these streets and over Sloat Boulevard from the Ferry Building at the foot of Market Street to the Fleishhacker Playfield at the Ocean Beach in the extreme southwestern section of the City. The present contract, costing $102,500, includes the construction of retaining walls and sewers and the grading and paving of the roadway. The Market Street Railway Company's tracks along a section of this improvement were relocated so as to fit the new line of roadway, the Company doing the work and sharing the cost with the City.

Grand View Avenue:

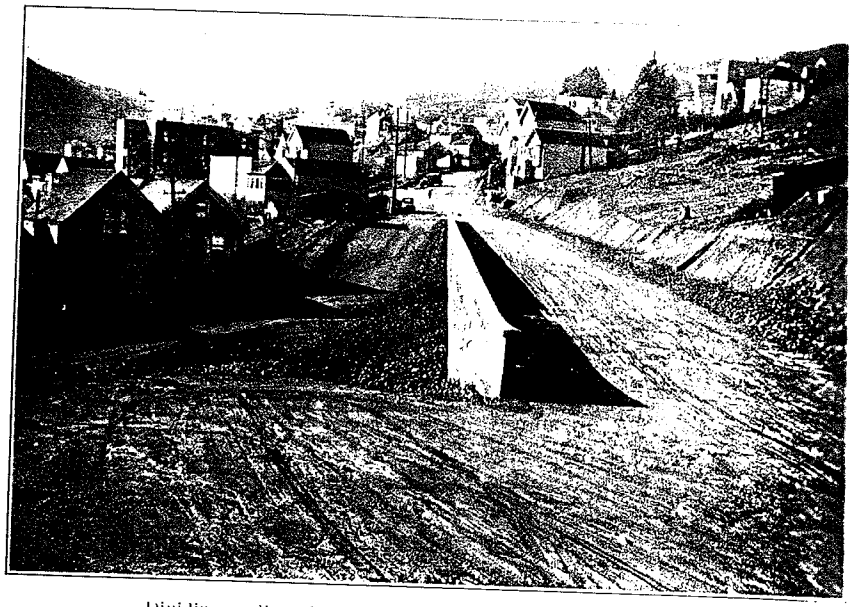
The grading and macadamizing of the roadway on Grand View Avenue from Stanton Street to a connection with Market Street extension at Elizabeth Street is now under way. This contract also includes the construction of 2,100 feet of sewers and the placing of 1,645 cubic yards of concrete in retaining walls. This improvement will give the Mission district further access to the Market Street Extension, providing a short route between the Mission and the West of Twin Peaks District.

Geneva Avenue:

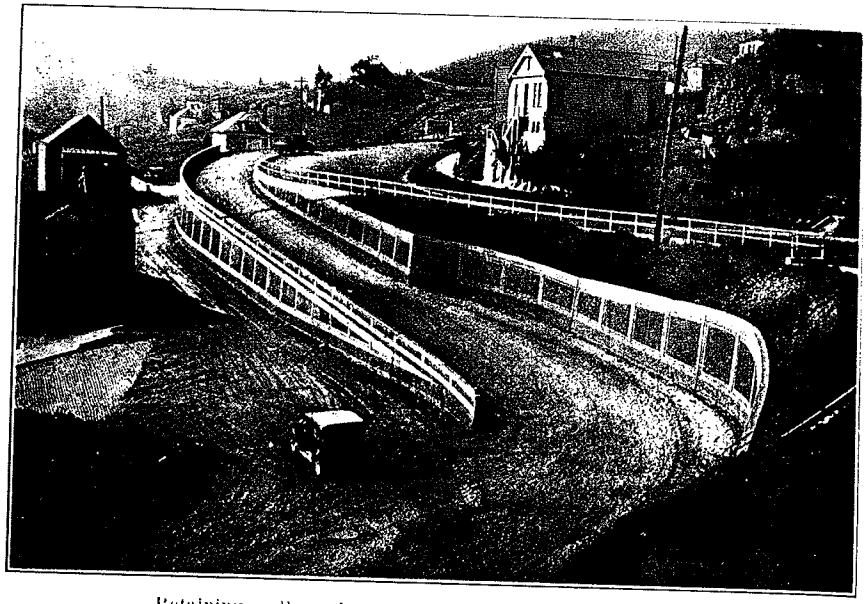
The completion of the pavement on a 20 foot width of Geneva Avenue from Prague Street to the County Line opened a direct cross-connection to the Bay Shore Highway over Geneva Avenue and Walbridge Street between Mission Street and San Bruno Avenue near and paralleling the County Line, thus eliminating the former circuitous traffic route. Provision was made for a future minimum width of 102 feet for highway purposes along this route.

Widening Streets:

In furtherance of the plan for making San Jose Avenue a part of the proposed crosstown Bernal Cut thoroughfare, embracing also Van Ness Avenue and Capp Street, the section of San Jose Avenue between Gorham and Cotter Streets was widened to a uniform width of 80 feet,

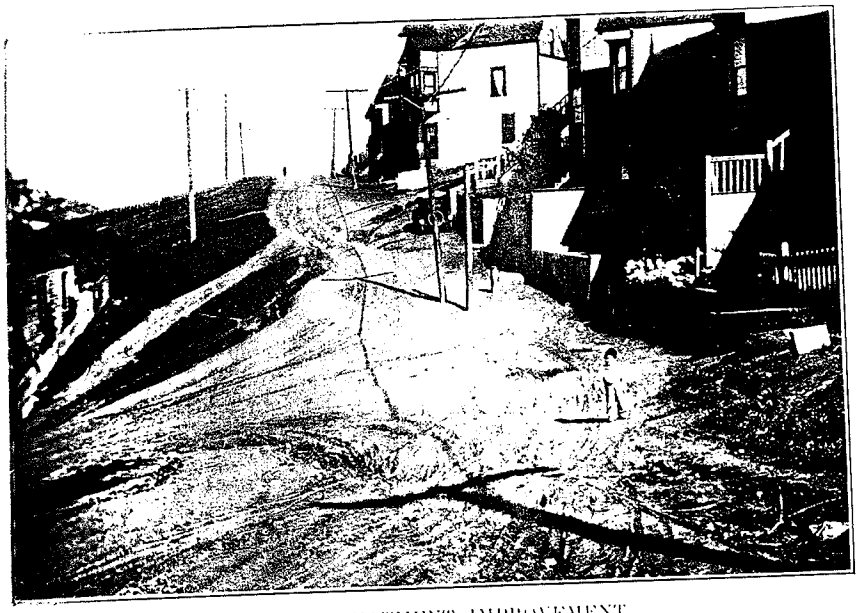


Dividing wall at intersection of street and through roadway



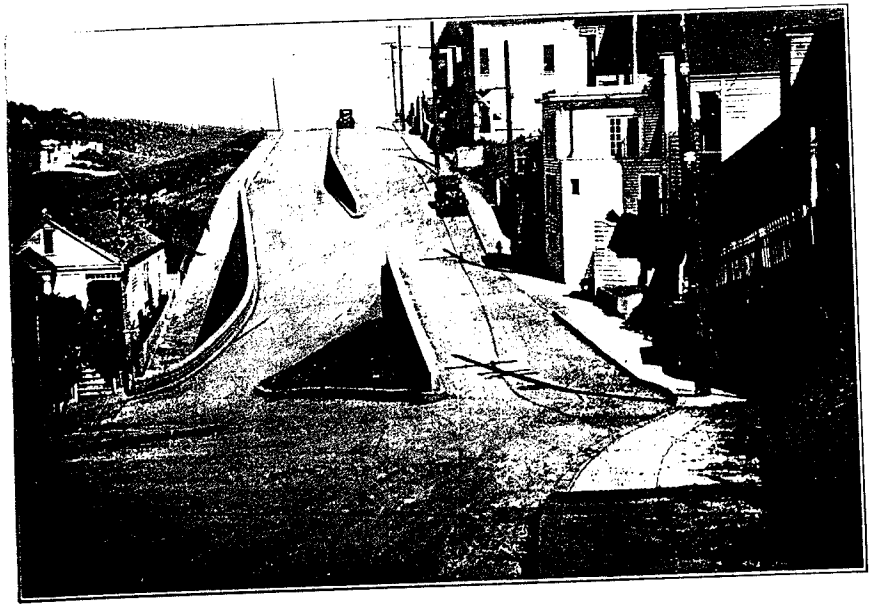
Retaining walls and ramp connecting with Market Street

GRAND VIEW AVENUE



SPECIAL TREATMENT IMPROVEMENT

Prattia Street easterly from Tomasa Street before and after improvement



the City purchasing the necessary property, and the improvement of this section is about completed. Property necessary for the widening of the section between Cotter and Ottawa Streets is now being acquired and a contract for this improvement will soon be let. This will then complete the improvement from Bernal Cut to the County Line.

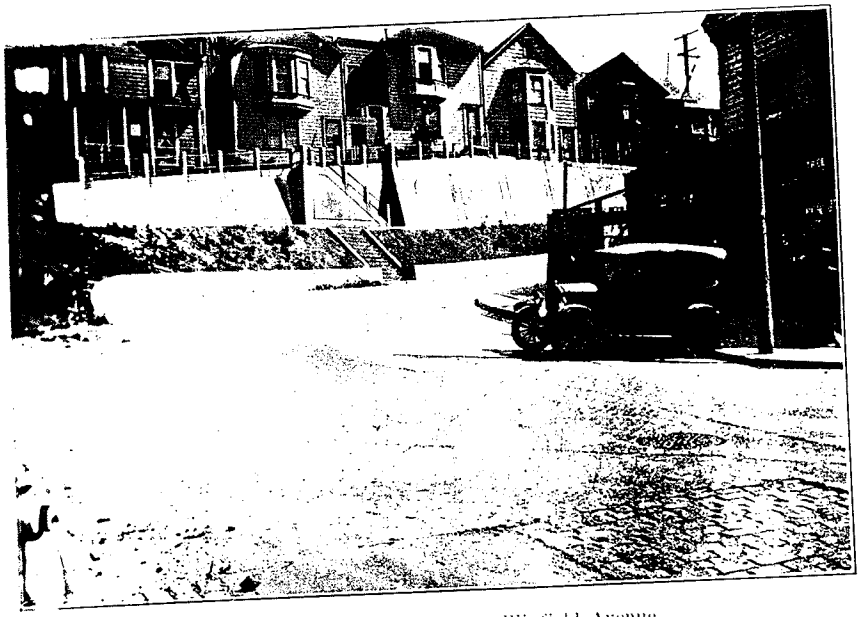
The widening of the roadway of Kearny Street from Market Street to Columbus Avenue, by cutting down the sidewalk on each side 4 feet, was completed. Similarly, the roadway of Clement Street between Arguello Boulevard and Funston Way was widened four feet and six feet was added to the roadway of Union Street between Franklin and Steiner Streets. These streets all carry double car tracks and, by narrowing the walks and setting back curbs, ample width between the cars and parked vehicles has been provided.

Special Treatment Improvements:

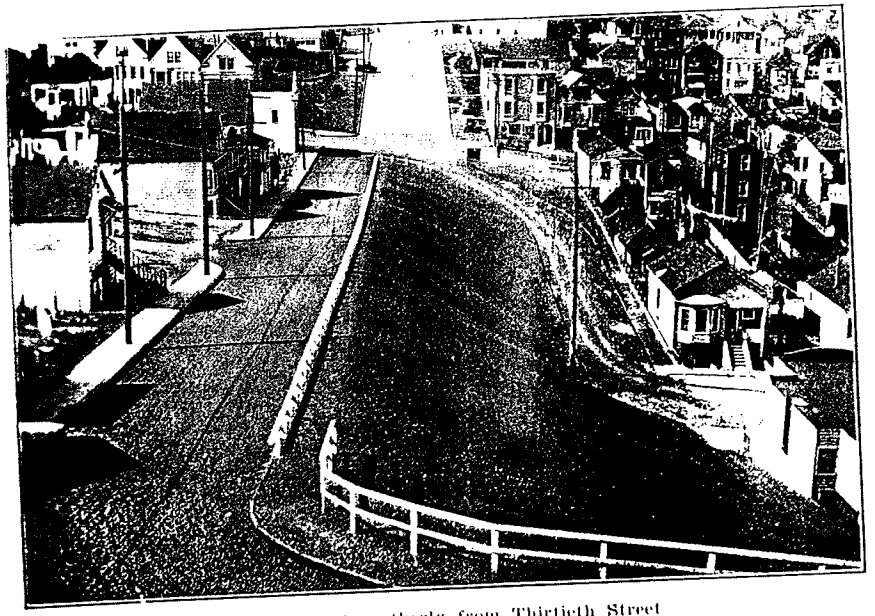
Improvements, distinctly local in character but requiring more than the ordinary treatment of local street improvements such as required double roadways, retaining walls, stairways, ramps, etc., are known as special treatment improvements.

The following tabulation shows the status at the end of the fiscal year of the several special treatment improvements under consideration by this department.

Location	Length	Approx. Cost	Status
Golden Gate Heights	4½ mi.	$425,000	Under construction
Peralta, Tomasa to Montcalm	1000 ft.	33,000	" "
Montcalm, Tomasa to Peralta	320 "	9,400	Plans completed
Holladay, Peralta to Adams	800 "	45,000	" "
Vermont St., 20th to 22nd Sts.	1210 "	35,000	Under construction
Castro St., 29th to 30th Sts.	1000 "	20,000	" "
Elizabeth St., Hoffman to Grand View	560 "	14,000	Completed
Laidley St., 30th to Noe Sts.	600 "	45,000	Plans completed
Carolina St., 19th to 20th Sts.	400 "	9,000	" "
Alpha St., Wilde to Tucker Av.	460 "	29,000	" "
Florence St., Vallejo to Broadway	275 "	7,000	" "
Saturn St., Ord to Lower Terrace	650 "	19,500	Completed
Douglass St., 20th to 21st Sts.	700 "	35,500	"
Virginia Av., Eugenia to Winfield	370 "	11,000	"
Bosworth and Congo Sts. (Glen Park)	2550 "	30,000	Plans incomplete
Ingerson Av., Hawes to Griffith	1400 "	49,000	" "
Kingston St., Coleridge to Prospect	225 "	9,500	" "
Santiago, 12th to 14th Av.	1000 "	52,000	" "
States St., Castro westerly	500 "	10,000	" "
Wolfe, Peralta and Mullins Intersection		15,000	" "

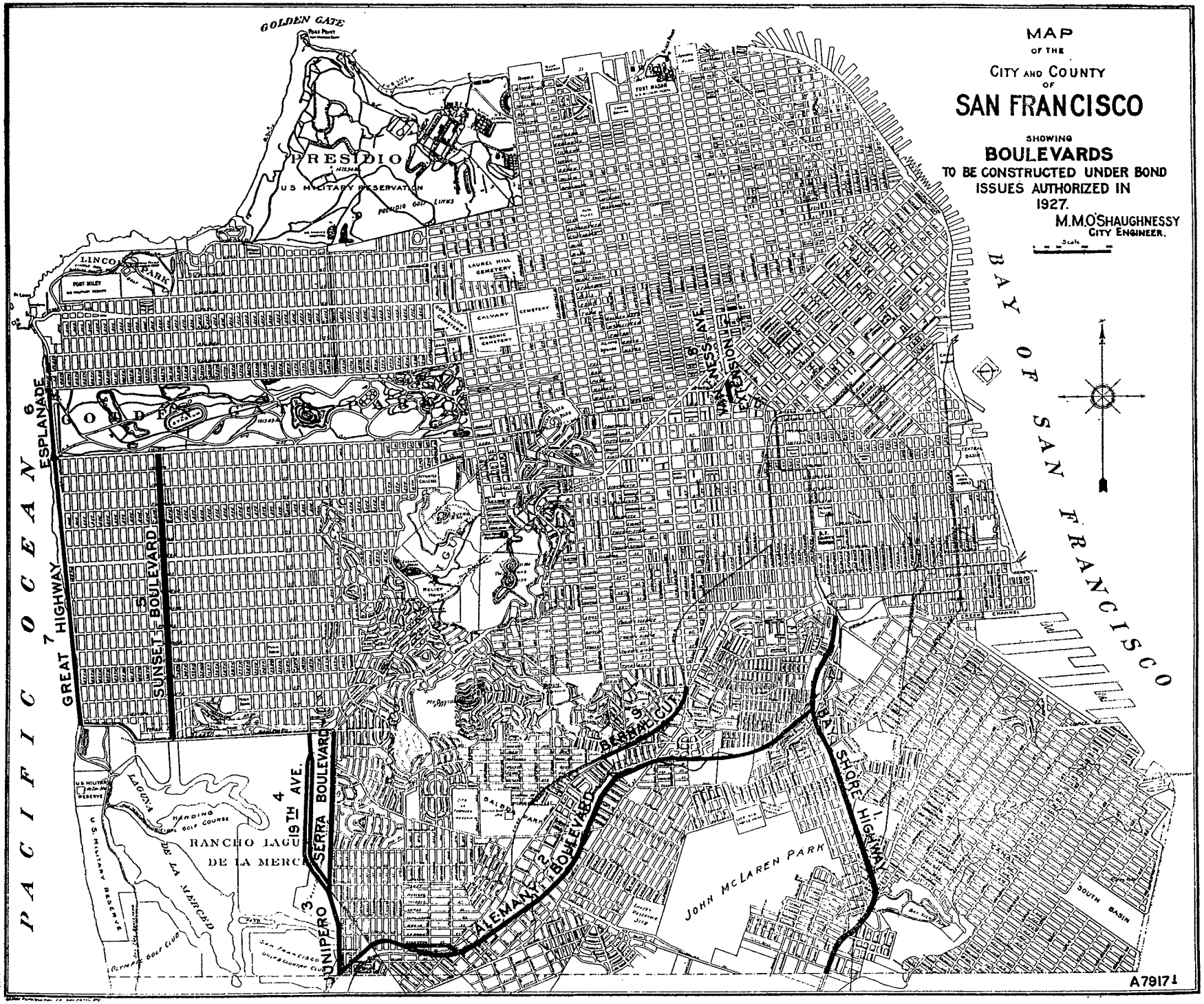


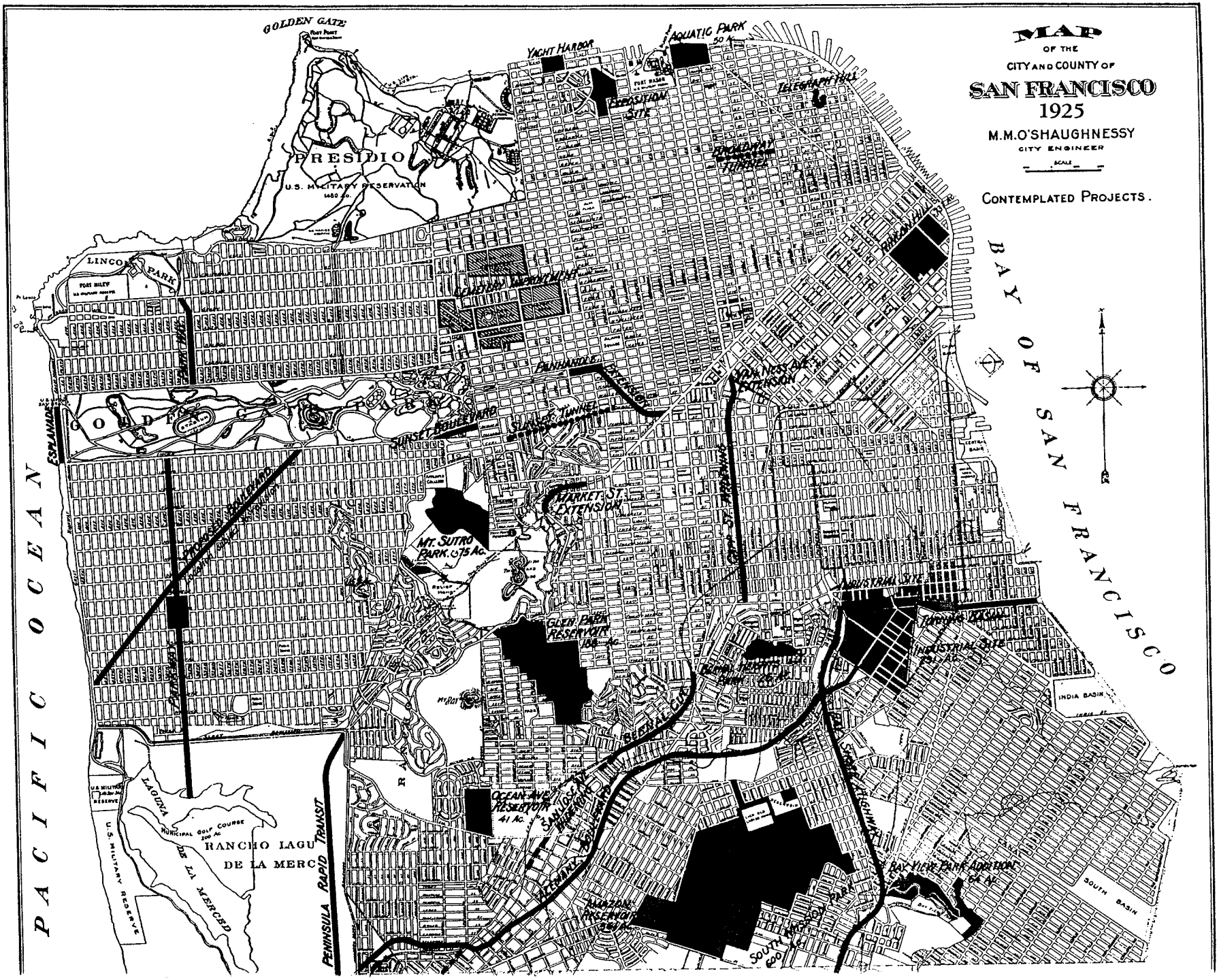
Virginia Avenue easterly from Winfield Avenue

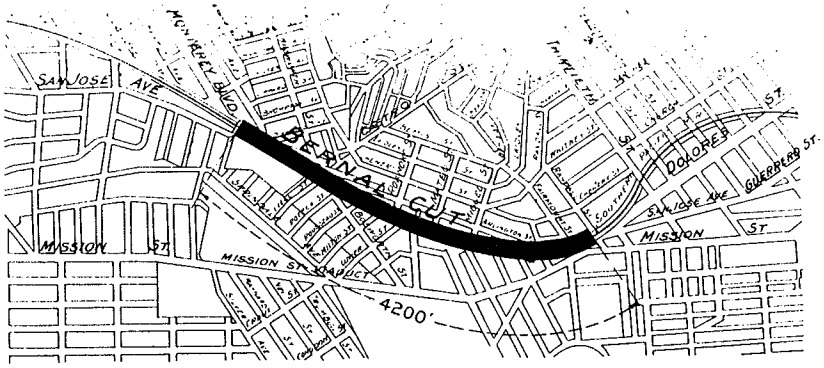


Castro Street northerly from Thirtieth Street

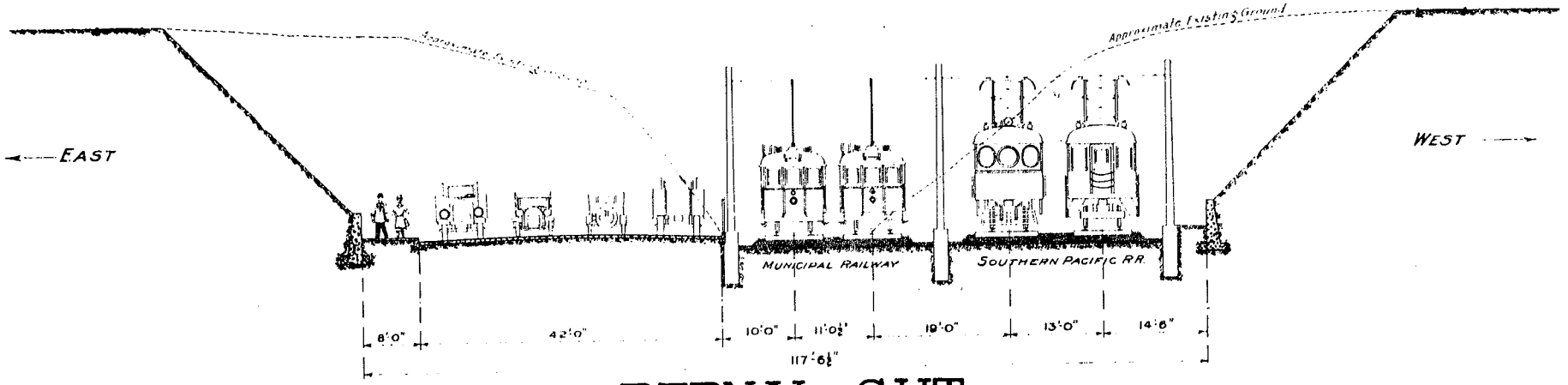
SPECIAL TREATMENT IMPROVEMENTS


MAP
OF THE
CITY AND COUNTY
OF
SAN FRANCISCO
SHOWING
BOULEVARDS
TO BE CONSTRUCTED UNDER BOND
ISSUES AUTHORIZED IN
1927.
M.M.O'SHAUGHNESSY
CITY ENGINEER.
GOLDEN GATE
PRESIDIO
U.S. MILITARY RESERVATION
PACIFIC OCEAN
BAY OF SAN FRANCISCO
6 ESPLANADE
7 GREAT HIGHWAY
5 SUNSET BOULEVARD
4 19TH AVE.
3 SERRA BOULEVARD
2 JUNIPERO BOULEVARD
1 ALEMANY BOULEVARD
VAN NESS AVE. EXTENSION
BAY SHORE HIGHWAY
JOHN McLAREN PARK
RANCHO LAGUNA DE LA MERCED
LAGUNA HONDA
LINCOLN PARK
A7917-1


MAP
OF THE
CITY AND COUNTY OF
SAN FRANCISCO
1925
M.M.O'SHAUGHNESSY
CITY ENGINEER
SCALE
CONTEMPLATED PROJECTS.
GOLDEN GATE
Fort Point
YACHT HARBOR
AQUATIC PARK 50 Ac.
EXPOSITION SITE
TELEGRAPH HILL
PRESIDIO
U.S. MILITARY RESERVATION
1480 Ac.
LINCOLN PARK
FORT MILEY
U.S. MILITARY RESERVE
GOLDEN GATE PARK
PANHANDLE
PANHANDLE EXTENSION
SUNSET BOULEVARD
STANYAN ST. TUNNEL
ESPLANADE
MARKET ST. EXTENSION
MT. SUTRO PARK. 675 Ac.
GLEN PARK RESERVOIR 15th Ac.
INDUSTRIAL SITE
INDUSTRIAL SITE 75 Ac.
INDIA BASIN
OCEAN AVE. RESERVOIR 41 Ac.
SAN JOSE BOULEVARD
BAY VIEW PARK ADDITION 64 Ac.
SOUTH BASIN
PACIFIC OCEAN
BAY OF SAN FRANCISCO
LAGUNA DE LA MERCED
MUNICIPAL GOLF COURSE 200 Ac.
RANCHO LAGU
DE LA MERC
PENINSULA RAPID TRANSIT
U.S. MILITARY RESERVE



LOCATION MAP



BERNAL CUT

TYPICAL SECTION IN CUT
LOOKING SOUTH.

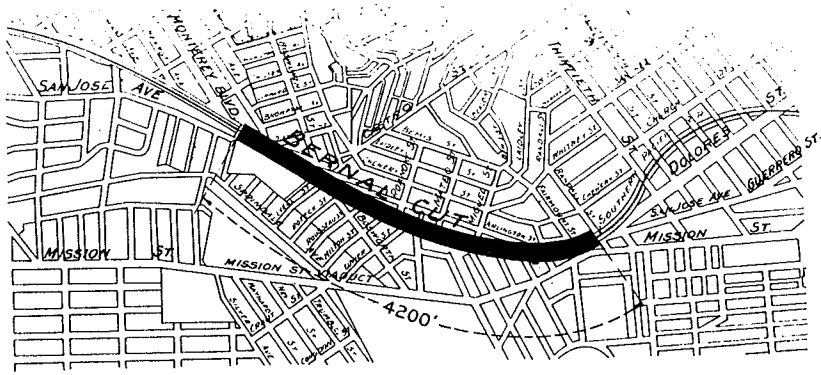
M. M. O'SHAUGHNESSY
CITY ENGINEER.

MARCH 1928.

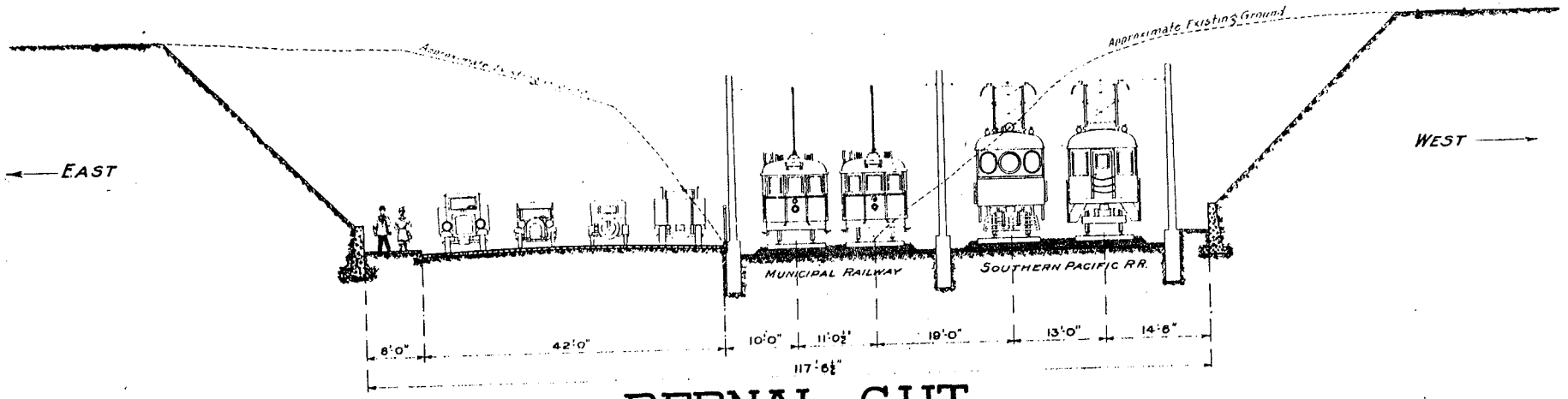
SCALE: ⅛ IN. = 1 FT.

SCALE OF FEET

A-7328



LOCATION MAP



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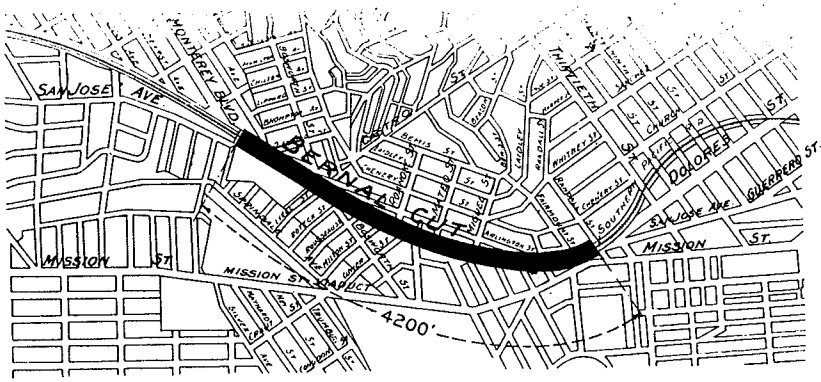
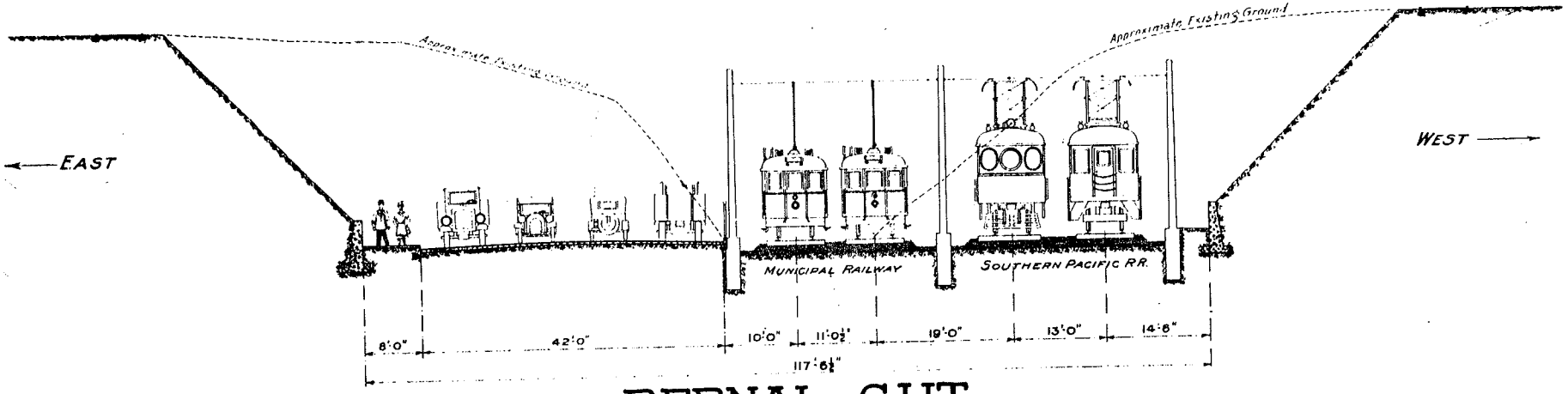


LOCATION MAP



BERNAL CUT

TYPICAL SECTION IN CUT
LOOKING SOUTH.

M.M.O'SHAUGHNESSY
CITY ENGINEER.

MARCH 1926.

SCALE: ⅛ IN. = 1 FT.

SCALE OF FEET

A-7328

6) A beach frontage improvement, being an extension of the present concrete **Esplanade** or seawall, running along and upon the Great Highway west of Golden Gate Park from Fulton Street southerly to Lincoln Way.

7) An improvement of the **Great Highway** from Lincoln Way southerly to Sloat Boulevard.

8) The extension of **Van Ness Avenue** from its present southern termination at Mission and Twelfth Streets southerly to Howard and 13th Streets.

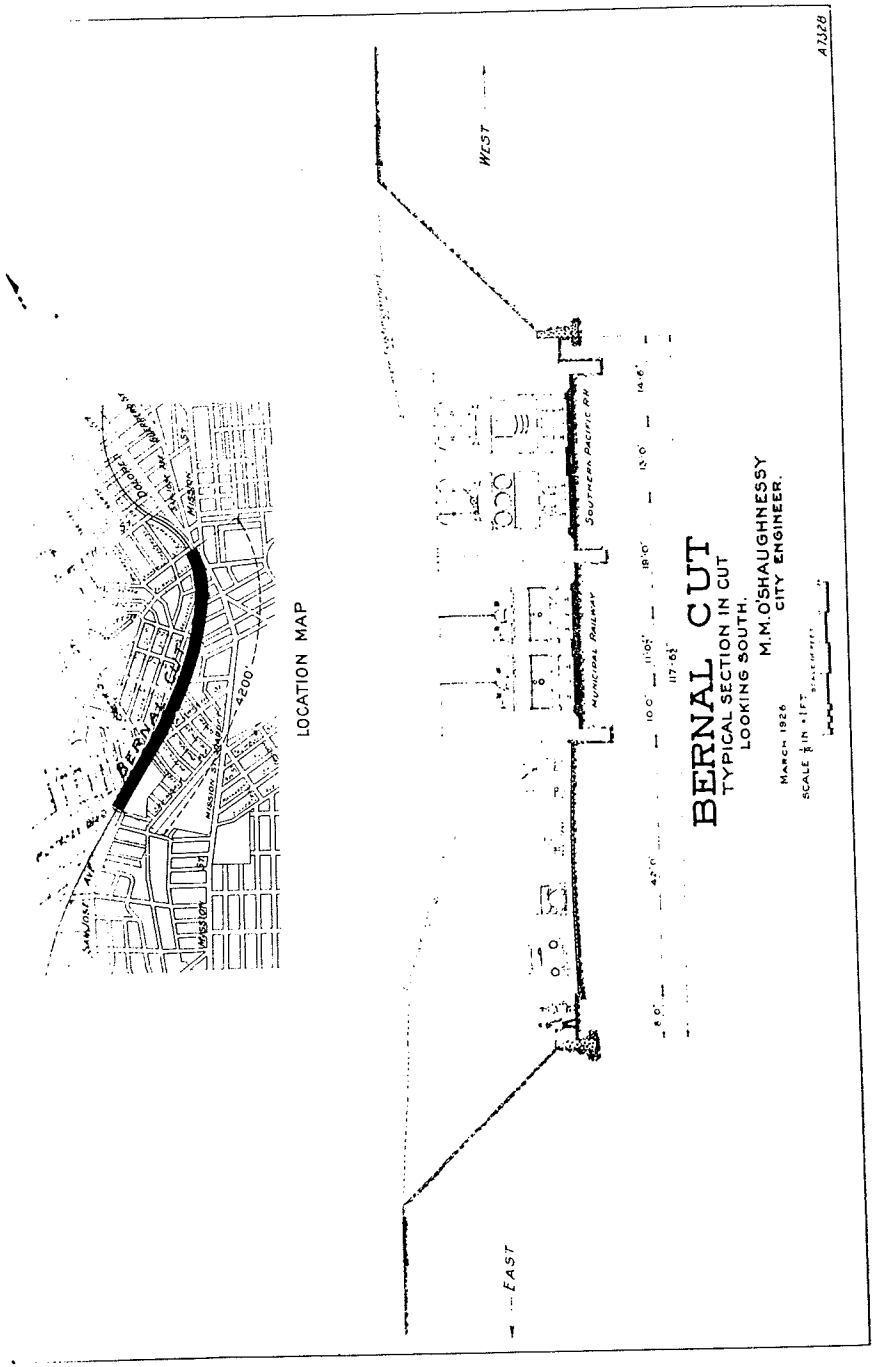
A summary of the above mentioned projects follows:

Name	Length Miles	Width Feet	Estimated Cost
1—Bay Shore Highway	3.01	125	$3,365,000
2—Alemany Boulevard	4.80	100	2,365,000
3—Junipero Serra Boulevard	1.80	125	850,000
4—19th Avenue Extension	1.25	128	500,000
5—Sunset Boulevard	2.10	240	*1,900,000
6—Esplanade, Fulton St. to Lincoln Way	.45	188	475,000
7—Great Highway, Lincoln Way to Sloat Boulevard	2.05	120	525,000
8—Van Ness Avenue Extension	.16	125	*500,000
Total	15.62		$9,380,000

*(For acquisition of necessary properties only.)

The proposed **Bernal Cut** improvement is an integral part of the system of highways planned within the City, and will join Dolores Street with the southerly section of San Jose Avenue, near Monterey Boulevard, thus adding another practical through route from Market Street to the County Line. This improvement, planned for years, is now assured of consummation. At a bond election held on June 14, 1927, the voters authorized the incurring of a bonded indebtedness of $1,400,000 for the acquisition, construction and completion of "A cut, or excavation with approach fills, providing an improved route for public highway purposes . . . known as the Bernal Cut . . . including approaches, structures, pavements, curbs, sidewalks, sewers, drainage facilities, the re-adjustment of intersecting and adjacent streets and other improvements, and the purchase of necessary lands." The vote on the bonds was: For 52,623; Against 17,952.

Prior to the bond election, plans for the work had been prepared in considerably greater detail than is customary. On account of the advanced work on the plans, it was possible to purchase property necessary for the work. With $135,000 made available out of the general fund, 33 per cent of the necessary property was acquired, plans were prepared and borings made to determine the character of the ground to be excavated.



Bernal Cut extends from the junction of Dolores Street and San Jose Avenue southerly to the intersection of Diamond Street and San Jose Avenue near Monterey Boulevard. The improvement will be 1[illegible] feet long, 117 feet 6 inches wide on the bottom, with slopes in the cut proper of 1½ horizontal to 1 vertical. The bottom width will be apportioned as follows: an 8 ft. sidewalk, a 42 foot vehicular roadway, a right of way for double tracks of the Municipal Railway and a similar right of way on the west side for the Southern Pacific Company, with retaining walls four feet high on either side of the bottom. The railway rights of way will not be paved, but will be fenced off from the vehicular roadway. There will be a sidewalk 6 feet wide constructed on the top of the cut on either side. The present cut of the Southern Pacific Company has a bottom width of 20 feet.

The estimated cost of the project, $1,400,000, is apportioned as follows:

$579,000 for Contract No. 1, $83,400 for Contract No. 2, $18,000 for Contract No. 3, $615,000 to acquire property, $44,600 for engineering, and $60,000 for contingencies.

Contract No. 1 will embrace the following items: 250,000 cubic yards of cut and 50,000 cubic yards of fill; the reconstruction of Randall Street between the Southern Pacific Company's right of way and Chenery Street; the construction of approximately 5,300 lineal feet of masonry retaining wall at the top of slope in the cut; a complete drainage system, a concrete bridge between Richland Avenue and Miguel Street; a concrete bridge extending from the end of Highland Avenue to Arlington Street, the removal of the existing arch bridge, and the construction of a concrete girder bridge at Bosworth Street—estimated cost $250,000. If no delays occur, work will commence on Contract No. 1 by May 1, 1928, and should be completed by September 15, 1929.

Contract No. 2, which will consist of a permanent asphalt pavement in the cut, all curbs in the cut, and a temporary macadam pavement on the fill; walks, coping, and fences; will cost approximately $83,400. Work should commence on this contract about September 30th, 1929, and ought to be completed by the end of January, 1930.

Contract No. 3 will consist of a permanent paving, curbs, walks, coping, and fence, and concrete steps from Bosworth Street to the top of the Bosworth Street Bridge—estimated cost $18,000.

Contract No. 3 should be awarded not sooner than June 30, 1930, so that the fill may have ample time for settlement. If this contract is awarded on June 30, 1930, the entire project should be completed by September 30, 1930.

It will be necessary to remove the existing bridges across the "Cut," i. e., the Charles Street Bridge, and the Richland Avenue-Miguel Street Bridge. The bridges removed will be replaced by reinforced concrete structures, one to be constructed at Highland Avenue and another connecting Richland Avenue and Miguel Street. At Fairmont Street, a small bridge carries the 30-inch riveted wrought iron main leading from San Andres Reservoir to College Hill Reservoir.

SPECIAL PROJECTS AND INVESTIGATIONS

Islais Creek Reclamation:

Work has progressed satisfactorily on plans for the reclamation of the Islais Creek District.

A decision (S. F. case No. 11948) establishing the legality of the district was handed down by the Supreme Court January 21, 1927, in an opinion written by Chief Justice William H. Waste. In accordance with the procedure set forth in the Act of Legislature approved April 1, 1925, the plans were submitted to the Board of State Harbor Commissioners of the State of California and approved by them on May 18, 1927.

The Trustees of the District formally adopted the plans and estimates on May 23, 1927, and filed two copies with the County Clerk on May 26th. On May 27, 1927, they filed plans, certified by the County Clerk, with the Clerk of the Board of Supervisors, with a request that the Board appoint three Assessment Commissioners who shall spread the estimated cost of the work in accordance with the benefits which the individual parcels of land will receive. The appointment of these Commissioners has been referred to the Street and Commercial Development Committee of the Supervisors and is under discussion at this time.

The estimated cost of the project is as follows:

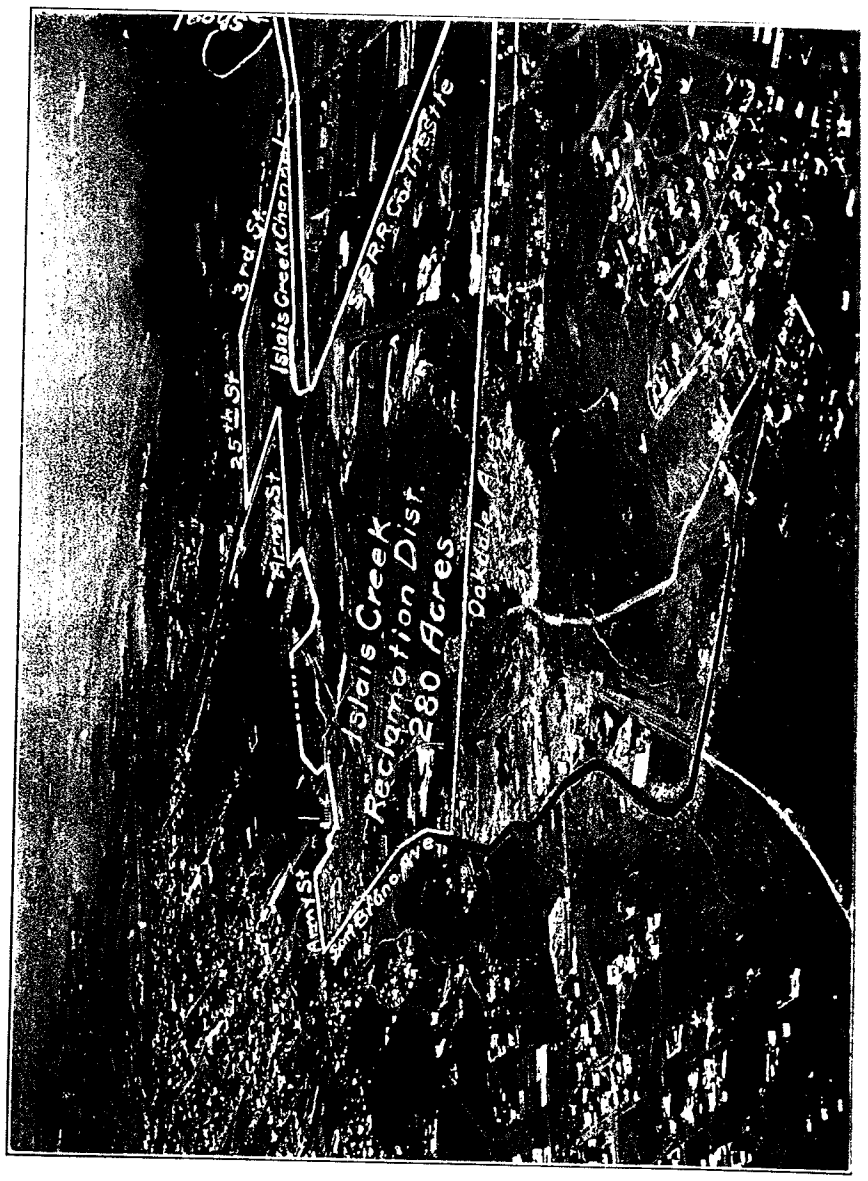
Fill	$ 866,285
Rock bulkhead wall	493,867
Sewer	160,000
Incidentals	50,000
Engineering, Inspection, Collection	50,000
Total	$1,620,152

The 280 acre site was surveyed and a contour map made on a scale of 1 inch equals 40 feet, with 1-foot contour interval. From the contour map, profiles were made so as to obtain the quantities of material for the purpose of estimating costs. Fill was calculated for each lot and each street and crossing.

Bay Bridges:

For many years the subject of a bridge over San Francisco Bay to the east bay cities has been agitated but it is only recently that the necessity for such a bridge has been conceded by practically all interests.

Up to the spring of 1927 eighteen separate applications had been made to the Board of Supervisors for a franchise to construct such a bridge. Right to grant such a franchise is vested in the county on the left bank of the stream descending, but the location is subject to approval by the War Department of the United States at Washington, acting through the military engineers who are in charge of rivers and harbors, and also by the engineer of the State of California.



Hearings about five years ago before the Supervisors led the War Department to announce a policy of no bridge north of Hunter's Point. In December, 1925, a rehearing was had and after several months deliberation the dictum was reannounced.

During the fall of 1926 the Board of Supervisors held public hearings on the applications for bridge franchises but accomplished nothing. On February 15, 1927, the Supervisors authorized the Board of Public Works to employ three expert engineers, selected from a list of ten submitted by the four local universities, to study the bridge problem in collaboration with the City Engineer, and to report their findings to the Supervisors.

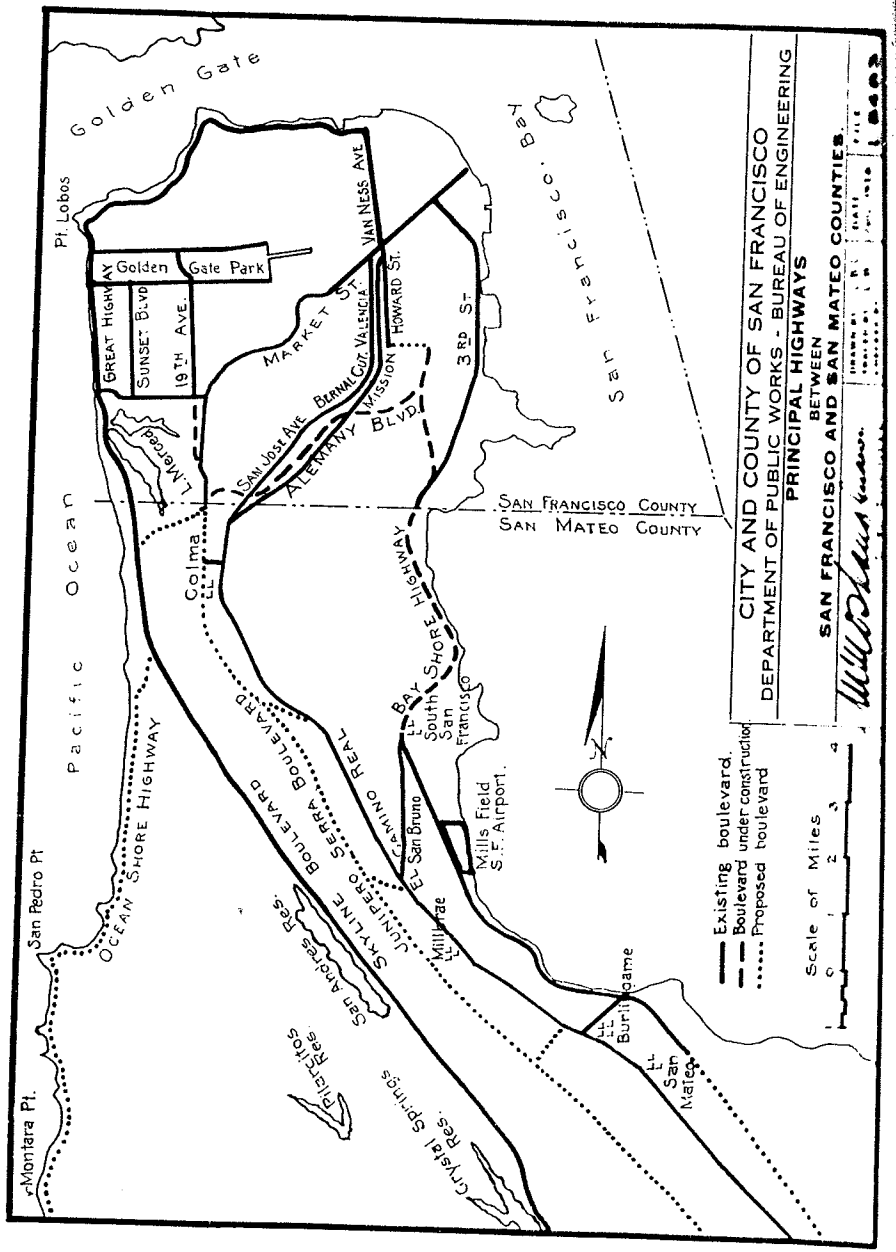
The enabling ordinance of the Board of Supervisors outlined their duties substantially as follows: to make a study, investigation and report on the three best locations in the order of their importance, the vertical clearance above water, the spaces between piers, the loads, facilities for traffic, and the financial problems involved in construction and completion of a bridge.

On March 24, 1927, the three engineers were appointed: John D. Galloway, Consulting Engineer of San Francisco; Robert Ridgway, Chief Engineer of the Board of Transportation of New York, and Arthur N. Talbot Professor of Engineering, retired, of University of Illinois, and on April 3rd their studies began. Meetings were held with naval officers, harbor officers, shipping interests, navigators, and others to determine advisable height and width of spans and to settle other physical problems. The facilities of this Department were opened to the Board of Engineers, and plans, maps, photographs, and all available data on soundings, etc., were furnished them. Their report was submitted to the Board of Public Works on May 9, 1927.

The Board of Engineers recommended as the best location that extending from Rincon Hill to Alameda Mole. A loop is provided for interurban trains on Fremont, Tehama, Seventh, and Bryant Streets. Limiting grades on approaches will be 4 per cent for trains and 6 per cent for automobiles. The central section of the bridge over the main part of the bay, 12,000 feet long, will have high level spans with 150 feet clearance above mean high water. There will be two 1250 foot spans next to the San Francisco water front followed by a series of spans of from 750 feet to 500 feet in length. The approach from Alameda Mole will be 4000 to 5000 feet in length. Railway and highway lines will reach Oakland by tubes.

The bridge will be designed to carry on a lower deck three interurban railway tracks, and on an upper deck a highway 42 feet wide, or sufficient for four auto traffic lanes.

Reasons set forth in the report for selection of this route as best are: it is the most available direct route between population centers on both sides of the bay; all existing interurban lines may reach the bridge; the Alameda and Oakland termini reach the principal traffic



REPORT

OF THE

BUREAU *of* ENGINEERING

OF THE

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF
SAN FRANCISCO

FISCAL YEAR ENDED JUNE 30, 1928

JAMES ROLPH, Jr. . . . *Mayor*

TIMOTHY A. REARDON
CHARLES E. STANTON
FRED W. MEYER
Board of Public Works

M. M. O'SHAUGHNESSY
City Engineer

Compliments of

BOULEVARDS, STREETS AND HIGHWAYS

The increase in use of automobiles has brought with it a demand for more and better roadways, not only the streets for local use but broad, well paved arteries for commercial traffic and boulevards to points of scenic interest both within the City and in the neighboring counties.

Prior to San Francisco's "Great Fire" of 1906, but little consideration was given to boulevards within the City. But two thoroughfares, Van Ness Avenue and Golden Gate Avenue, were then paved with asphaltic surface. The automobile was just beginning its influence for better roadways.

The Burnham plan, developed about 1906, sponsored by public spirited citizens, proposed establishment of broad, arterial streets and in many places the establishment of new streets on better grades than those in the existing checker board system. Due to the chaotic conditions subsequent to the Fire, the plan was dropped, altho the devastation of a portion of the City would have made its consummation easier. Street reconstruction went on as funds permitted, under no well ordinated plan.

In 1913, this department, under M. M. O'Shaughnessy, as City Engineer, formulated a complete boulevard plan and mapped out a program for its gradual development. Without special taxation or special appropriations the system has been gradually completed, having been financed almost entirely by funds received from the state tax on automobiles and gasoline, amounting then to less than $100,000 annually, but now approaching $1,000,000 and aggregating twelve million dollars.

The 1913 program included construction of the Marina Boulevard, a 100 foot thoroughfare 4500 feet long from Laguna Street to Lyon; Hunter's Point Boulevard, 80 feet wide and 10,300 feet long from Third Street to Hunter's Point; Twin Peaks Boulevard, 40 feet wide and two miles long from Clayton Street to Portola Drive, encircling Twin Peaks at 900 feet elevation; Market Street Extension, 70 feet wide, extending 7200 feet from Seventeenth Street to Twenty-fourth Street and Portola Drive which leads to Ingleside; Sloat Boulevard, 135 feet wide, and two miles in length from Portola Drive to the Ocean Beach; and Bernal Cut, 117 feet wide and 4200 feet long.

This program has been completed excepting the last unit, the Bernal Cut. Issuance of bonds to provide funds for the improvement of the Cut was authorized June 14, 1927, as noted in the last annual report.

While the 1913 program was being carried through, there was a tremendous increase in the use of automobiles and with it a strong demand for additional traffic facilities. The demand was not only for streets in the City, but also for avenues of approach to the suburban areas in San Mateo County, which were the more popular because travel to and from the counties north and east is throttled by the delays and inconvenience of ferry travel.

The City Engineer therefore proposed the boulevard bond issue of $9,380,000 for the construction of 15.62 miles of highway as outlined in the last annual report. This bond issue was authorized November 8, 1927, by the vote: For, 92,867; Against, 25,638. On November 26, the City Engineer requested that funds be made available as follows:

Feb. 1, 1928	$2,500,000
July 1, 1928	2,500,000
Jan. 1, 1929	2,500,000
July 1, 1929	1,880,000
Total	$9,380,000

This would allow completion of the boulevards as planned, including paving, by June, 1930, allowing sufficient periods of time for fills to settle in the interim.

In accordance with the City Engineer's recommendation the first block of bonds was sold on February 27, 1928, and preparations are well forward for the sale of the second block.

Bay Shore Boulevard from Potrero Avenue to the County Line, a distance of 3.01 miles, will consist of a 100-foot roadway with sidewalks 12.5 feet wide. The State is about to receive bids for extension of this highway southerly from the County Line to South San Francisco, a distance of about 3.5 miles, for approximately $700,000. The City's work is divided for construction purposes into five sections, A, B, C, D, and E and these again in some cases, into separate contracts.

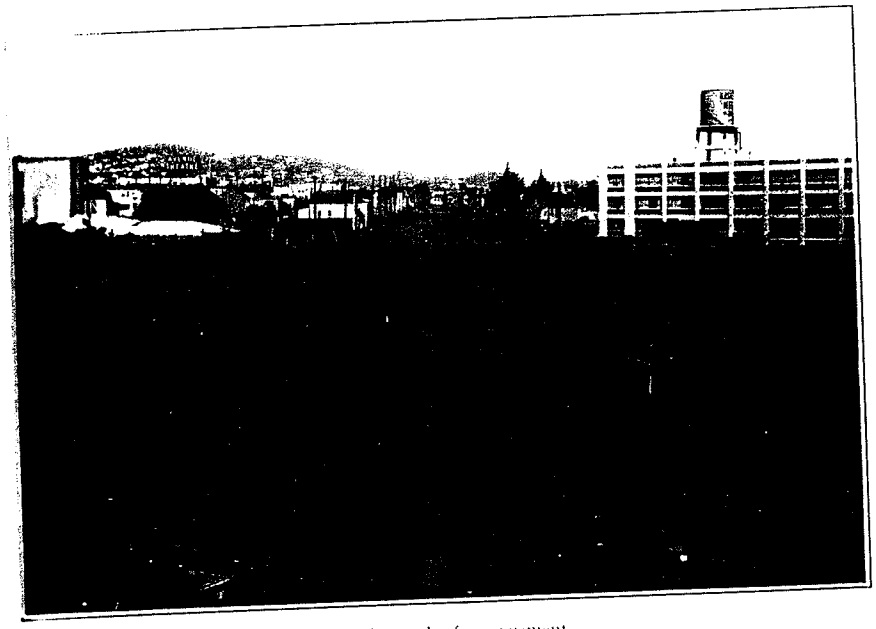
Section A extends from Potrero Avenue to Silver Avenue, a distance of 6,000 feet. Contract No. 1 for this section was awarded on June 11, 1928, to L. J. Cohn for the estimated price of $224,347.98 for grading, sewer, pavement, etc. Work has been begun. A second contract, later on, will cover the construction of pavement on portions of the above where new fill is being made and permanent pavement cannot now be placed. This section should be ready for use about January, 1929.

Section B extends from Silver Avenue to Paul Avenue, a distance of 3719 feet. The construction of this section is being done under one contract awarded March 2, 1928, to Federal Construction Company in the estimated amount of $139,909.58, and due to be completed in December, 1928.

Section C, 2119 feet long, from Paul Avenue to Third Street, will be done under two contracts, neither of which has been yet awarded on account of difficulty in acquiring the numerous parcels of land necessary for the improvement.

Section D, 1600 feet long from Third Street to Tunnel Avenue near San Bruno Avenue will be constructed under one contract of the estimated value of $237,000. This contract should be let during August.

Heavy cut in rock



Subgrade ready for pavement
BAY SHORE BOULEVARD

Section E, 2500 feet long, from Tunnel Avenue to the San Mateo County Line, will be constructed under one contract, estimated at $1.., 000. This also has been delayed on account of property acquisition.

At the intersection of Bay Shore and Alemany Boulevard, a storm drain to carry the flow of Islais Creek is being constructed out of boulevard funds under a contract awarded March 2, to L. J. Cohn in the estimated amount of $59,594.40. Work is 35 per cent complete and should be finished in September. The drain is a reinforced concrete conduit 454 feet long, consisting of two compartments each 8 feet 6 inches by 11 feet, and resting on piles from 60 to 85 feet long, set four to a bent, with bents at 2 feet 3 inches center to center. The heavy foundation is used to give the drain sufficient bearing power to support an industrial spur track that is planned for the future.

Alemany Boulevard has been divided into six sections. This boulevard is 100 feet wide, with 80-foot roadway and two 10-foot sidewalks.

Section A, 7100 feet long, extends from Bay Shore Boulevard to Mission Street. Plans are under preparation.

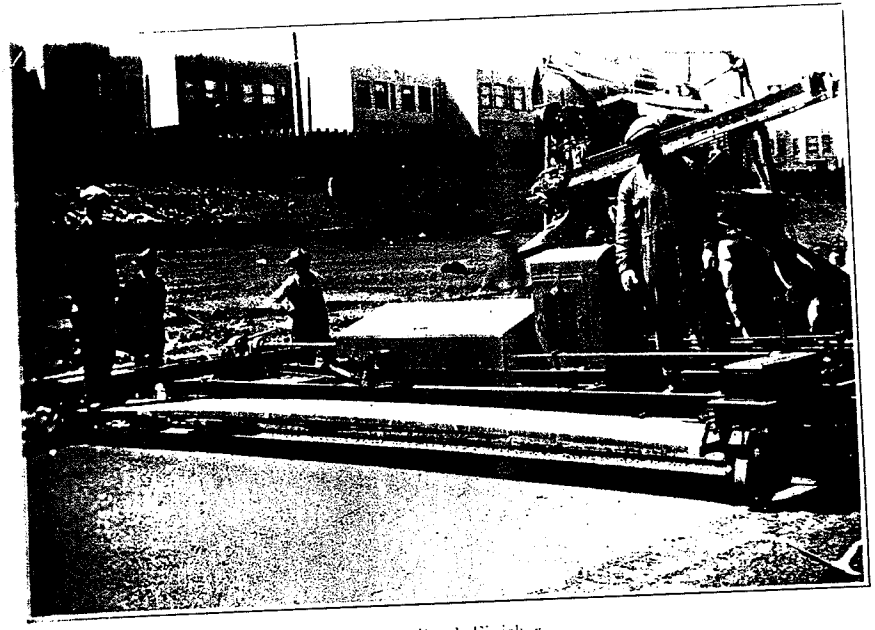
Section B, 3900 feet long, from Mission Street to Ocean Avenue, will be constructed under two contracts. The first of these was awarded March 10, 1928, to Eaton & Smith for the estimated amount of $106,763.41. The work is 42 per cent complete and should be finished by October. The second contract will be for the permanent paving of the portions of Contract No. 1 that are on fills which must be allowed one season for proper settlement.

Section C, 7800 feet long from Ocean Avenue to San Jose Avenue will be constructed under two contracts. Acquisition of necessary properties is not yet complete.

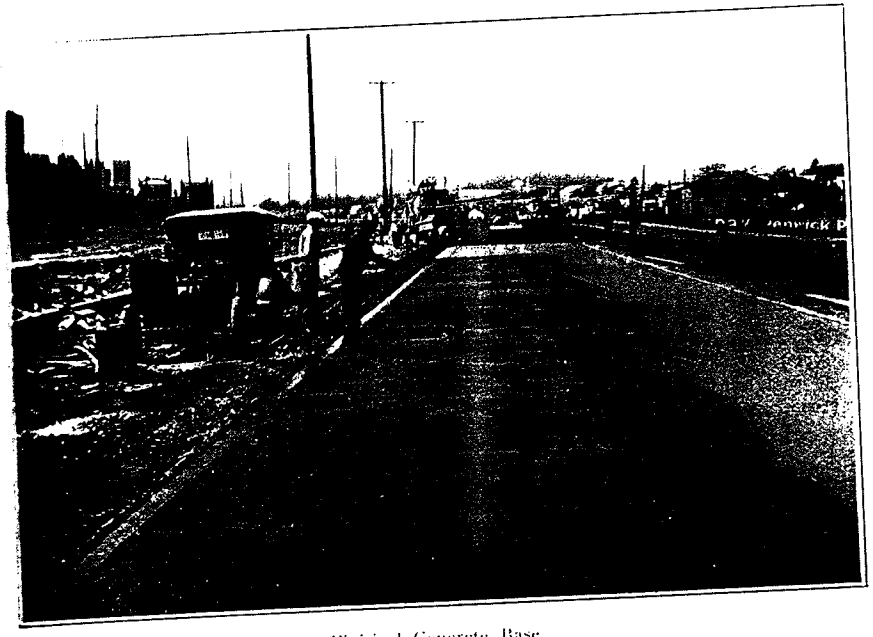
Section D, from San Jose Avenue to Orizaba Avenue, a distance of 1630 feet, will probably not be constructed for some time, on account of the heavy expense of boulevard and railway grade separation, but for the present the boulevard will be routed over Section D1 along Sickles Avenue and Sagamore Street, a distance of 2300 feet, to Orizaba Avenue. Contract for this latter work, for the estimated sum of $58,500 should be let in September.

Section E, from Orizaba Avenue to Junipero Serra Boulevard, a distance of 2710 feet, will be built under two contracts estimated at $75,000 and $50,000, respectively, which should be awarded in August. Properties are now being acquired.

Junipero Serra Boulevard as now existing is a 25-foot paved roadway on a 45-foot right of way. The new plans provide for a 100-foot pavement and two 12½-foot sidewalk areas for a length of 1.80 miles from the intersection of Portola Drive with Sloat Boulevard to the San Mateo County Line. The work will be done under two contracts on which the estimates aggregate $600,000. Negotiations for rights of way have de-

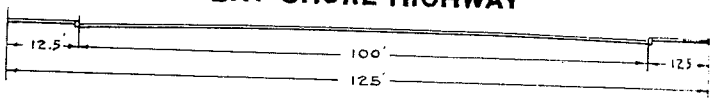


Concrete Road Finisher

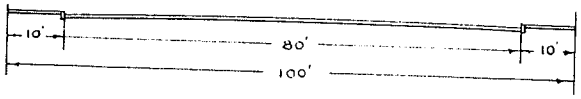


Finished Concrete Base
ALEMANY BOULEVARD

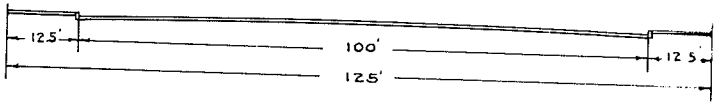
BAY SHORE HIGHWAY



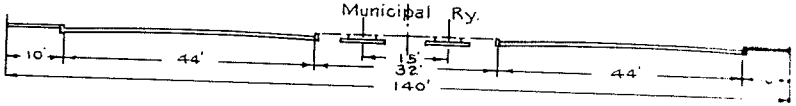
ALEMANY BOULEVARD



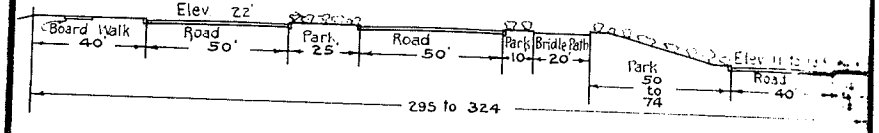
JUNIPERO SERRA BOULEVARD



NINETEENTH AVENUE



GREAT HIGHWAY

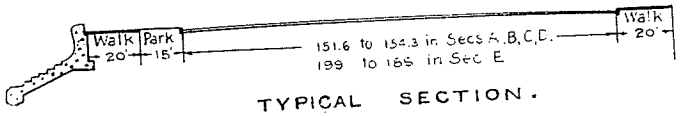


CITY AND COUNTY OF SAN FRANCISCO
DEPARTMENT OF PUBLIC WORKS - BUREAU OF ENGINEERING

BOULEVARDS UNDER CONSTRUCTION THROUGH BOND ISSUE OF 1927.

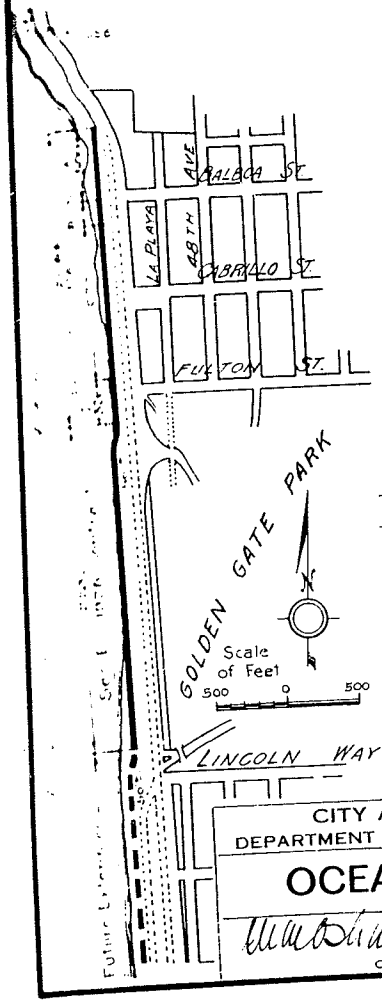
CITY ENGINEER

DRAWN BY L.B.C.	DATE June 6. 1928.	FILE L 8344.
TRACED BY L.B.C.		
CHECKED BY		



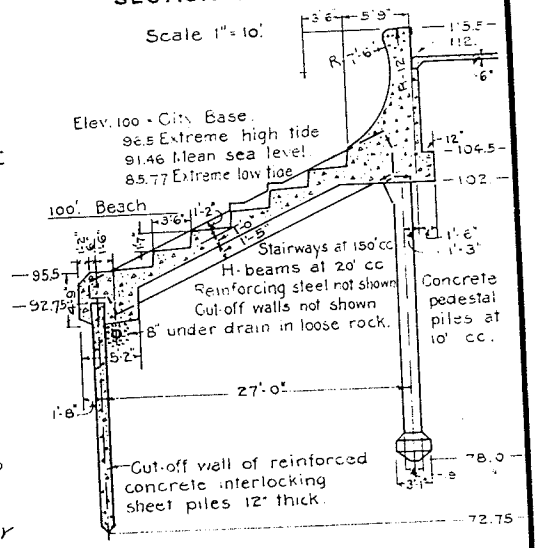
TYPICAL SECTION.

Scale 1"=40'



SECTION THROUGH CONCRETE.

Scale 1"=10'



CITY AND COUNTY OF SAN FRANCISCO
DEPARTMENT OF PUBLIC WORKS - BUREAU OF ENGINEERING

OCEAN BEACH ESPLANADE.

CITY ENGINEER

DRAWN BY L.B.C.	DATE May 11. 1928.	FILE L 8343.
TRACED BY L.B.C.		
CHECKED BY		

layed actual construction and it is expected that contracts will be awarded in October.

An extension of the Junipero Serra Boulevard 12 miles long to Burlingame, known at present as the **Bi-county Highway,** is contemplated by co-operation of San Francisco and San Mateo Counties as a joint highway district. Plans are maturing rapidly for construction of the 3½ mile section from the County Line southerly and southeasterly to a junction with El Camino Real between Lawndale and San Bruno, beyond the so-called "bottleneck."

Nineteenth Avenue will be extended southerly from its intersection with Sloat Boulevard, along a 100 foot right of way with 80 feet of pavement and two 10-foot sidewalk areas, to an intersection with the Municipal Railway right of way. Here the boulevard widens to 140 feet of right of way, of which the railway occupies the central 32 feet. Two roadways, each 44 feet wide, will straddle the railway strip, with 10-foot sidewalk areas next the outer property lines. This plan will continue to an intersection with the new Junipero Serra Boulevard at Worcester Avenue.

Acquisition of rights of way is practically complete, plans have been prepared, and it is expected that bids will be received in October.

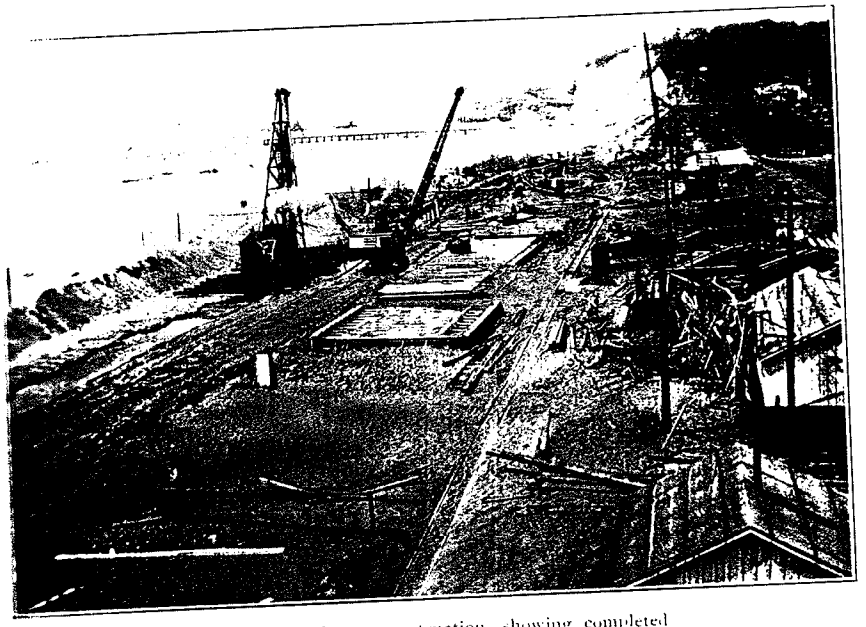
This work will be done under three contracts aggregating $442,000. The first contract will include all grading and all pavement in cut. After the fills have settled they will be paved under the second contract. The third contract covers reconstruction of about 2300 feet of 18 inch cast iron pipe sewer, which will be relaid along the edge of the pavement.

Sunset Boulevard involves only acquisition of a strip of land 240 feet wide, from Golden Gate Park to Sloat Boulevard, under this bond issue. To date $66,041.50 has been spent for this purpose. The total estimated value of lands to be bought is $1,900,000.

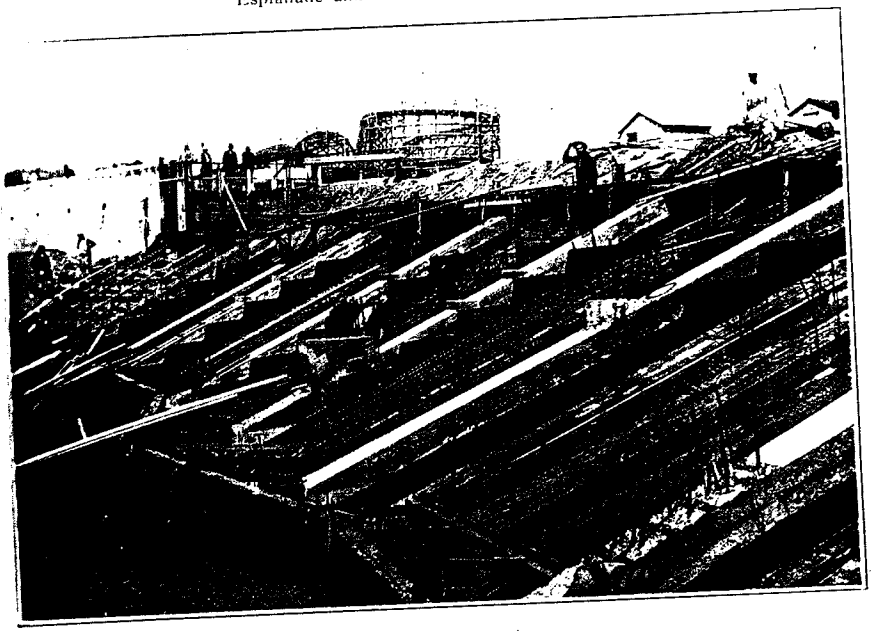
Ocean Beach Esplanade construction has proceeded satisfactorily. Owing to the fact that no lands nor rights of way had to be purchased, this work was under way in advance of other items included in the Boulevard Bonds.

Contract No. 1 for construction of 2232 feet of Esplanade along the Ocean frontage of Golden Gate Park was awarded on March 2, 1928, to Healy-Tibbitts Construction Company for the estimated amount of $329,948. A second contract for the estimated sum of $90,000 will later on be entered into for paving the adjacent area. The width of roadway varies from 188 to 199 feet. The present contract should be completed by April, 1929. This will give a finished length of 4298 feet of concrete Esplanade from Sutro Heights to the southerly line of Golden Gate Park.

Great Highway is being improved from Lincoln Way to Sloat Boulevard, a distance of 2 miles. This development consists of a board walk fronting the Ocean Beach, two 50-foot roadways separated by a 25 foot



General view of new construction, showing completed Esplanade and Cliff House in distance



Construction of Bleachers
OCEAN BEACH ESPLANADE

parked strip; a parked strip varying in width around 100 feet and mak... ing a 20-foot bridle path; a future lower roadway 40 feet wide on t... east side and a sidewalk varying in width from 10 to 15 feet. Two ... pedestrian underpasses will be provided, one at Judah Street near t... Ocean Terminus of the new Municipal car line and one at Taraval Stre... Bids will be received July 11, 1928, for Contract No. 1, on which t... engineer's estimate is $154,694.50, covering grading, temporary macada... pavement 8 inches in thickness with oiled wearing surface, drainag... lighting, underpasses, etc. A second contract, to be let in about a year... will include construction of permanent pavement, which will be bla... base 3½ inches thick and with 1½-inch wearing surface, placed on t... of the temporary macadam. Estimated cost of Contract No. 2 is $220,00...

Van Ness Avenue Extension, the eighth and last item in the $9,35... 000 bond program, calls for an expenditure of $500,000 for the pu... chase of property necessary to extend this 125-foot avenue 0.16 m... from Mission Street to Howard Street at Thirteenth Street. No fi... action has yet been taken by the Supervisors on the City Engineer's re... ommendations for location and alignment of the extension.

In this boulevard construction, permanent pavement is being la... only where the roadway is in cut and offers no chance for settlement. For all jobs except the Great Highway, in which black base will be used, the permanent pavement consists of an 8-inch concrete base with 1... inches of asphaltic binder and 1½ inches of asphaltic concrete wearing surface.

The asphaltic wearing surface and binder are of the thickness an... grade that have proven most satisfactory for the conditions in this City.

The concrete specifications have been revised to fix the amount of cement at 6 sacks per cubic yard of finished concrete, to especially stre... the quality and grading as to size of the rock and sand, and to fix a definite water content.

These modifications of specifications together with an increase of thickness of concrete base from 6 inches to 8 inches, are resulting in pavement of better quality than has heretofore been laid in San Francisco.

In fills or other places liable to settlement a temporary macadam pave... ment 8 inches thick with oiled surface is laid now, with its surface at such elevation that it will serve as a base for the concrete which will be laid after the fill is thoroughly compacted by a season or more of weathering.

In all boulevards under construction conduits are being installed for lighting and for the various traffic signals, and electroliers are being erected.

In addition to the main boulevards above mentioned, it is now planned to give San Francisco another main outlet to the south by the construction of the tri-county **Ocean Shore Highway,** which will extend from Junipero Serra Boulevard across the Skyline Boulevard and thence ... the coast generally along the line of the abandoned Ocean Shore Railway, to Santa Cruz, a distance of 76 miles. This highway will have a width of 10 feet on a 100-foot right of way and will be built on easy grades. Preliminary estimate of cost is $5,300,000, which will be borne largely by San Francisco with minor assistance from San Mateo and Santa Cruz Counties. Steps are now being taken toward the formation of a joint highway district comprising the three counties.

Bernal Cut Boulevard plans have been completed and it is contemplated that the work be done in two contracts.

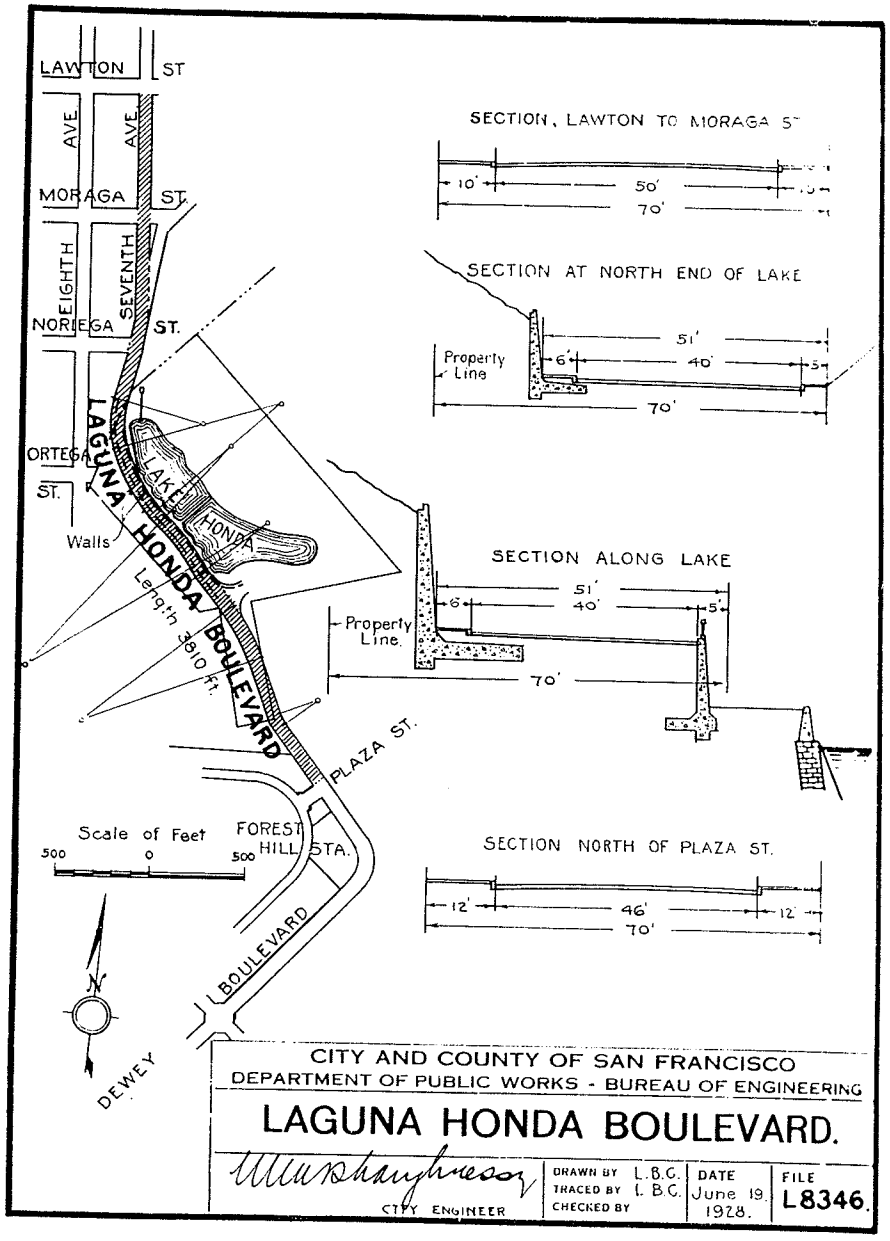
Contract No. 1 includes the removal of all bridge structures within the boundaries of the project, notably the arch structure now carrying the Southern Pacific tracks over Bosworth Street, the vehicular bridges over the railroad at Charles Street, and the foot-bridge and pipe bridge at Fairmont Street. A new bridge of concrete girder type will be constructed at Bosworth Street to carry the double tracks of the Southern Pacific Company, the double tracks of the proposed Municipal Railway extension, a 42-foot vehicular roadway and an 8-foot sidewalk. Estimated cost of this bridge is $220,000. A concrete vehicular bridge, estimated cost of which is $40,000, will be built across the cut to connect Highland Avenue to Arlington Street. A third bridge, estimated to cost $11,000, will be built for pedestrian traffic from Richland Avenue to Miguel Street. The water main supplying College Hill Reservoir will cross the cut underground in the form of an inverted siphon.

The contract will also include grading and construction of walls, roadways, sewers, pavement and coping and necessary electrical work at a total cost of approximately $550,000. Permanent pavement will be placed on portions of the roadway that are in cut and temporary pavement on the portion that is to be constructed on fill. It is estimated at this time that bids will be received by the middle of September, 1928. It will take approximately $570,000 for completion of this work.

Contract No. 2 will provide for final permanent pavement on that portion that was temporarily paved under Contract No. 1 and should not be entered into less than one year after the completion of Contract No. 1. This will cost approximately $20,000.

Contract No. 1 could have been let and work begun except for the delay occasioned by the Supervisors in failing to authorize the Mayor to enter into an agreement for exchange of lands with the Southern Pacific Company, which now operates a rail line at the site.

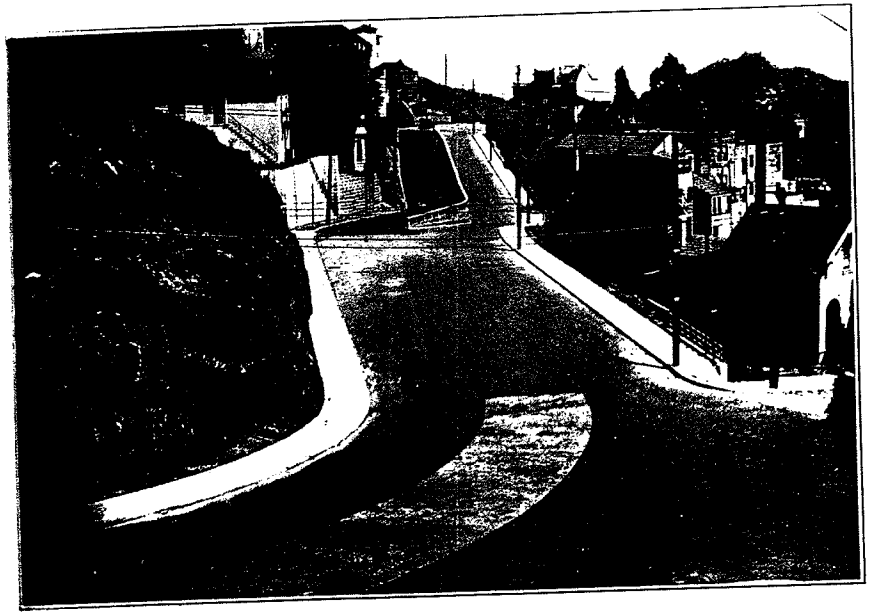
Market Street Extension, Section B, from Mono Street to Ord Street, on which grading, concrete walls, etc., were completed early in the year, has been paved with asphaltic concrete. The portion of the pavement on heavy fills is of a temporary nature and consists only of an asphaltic wearing surface over a macadam base. This extension 2260 feet long consists of a 54-foot roadway and two 8-foot walks. It con-



feet to the south with Section C, a 46-foot roadway on a 70-foot right of way 3450 feet long, extending to Twenty-fourth Street, which has been completed for several years.

From Twenty-fourth Street southerly and westerly the Market Street extension is known as **Portola Drive.** This is at present a narrow, winding paved roadway for 3360 feet until it opens out to a paved width of 80 feet. During the year, 500 lineal feet of this wide pavement has been laid to meet tract improvements adjacent thereto. Plans are complete for widening the narrow pavement to 80 feet, with two 10-foot sidewalks, and for improving the alignment. In advance of the letting of a contract for this work fill is being placed where necessary as fast as material is available. The estimated cost of this work complete is $153,500.

Laguna Honda Boulevard is an important crosstown arterial link from Seventh Avenue in the Sunset District to Forest Hill, whence there are connections to Portola Drive and the main boulevards to the south. At present there is a narrow strip of temporary pavement along Laguna Honda, a distributing reservoir of the Spring Valley Water Company. This department has been striving for several years to secure an appropriation for improving this roadway to proper alignment and sufficient width, and plans for the work were completed about three years ago, but



ROOSEVELT WAY

so far, funds for the entire project have not been provided. An essential preliminary is the construction of a sewer, which is now under way, as noted elsewhere in this report. It is to be hoped that the boulevard construction may follow immediately upon completion of this preliminary work.

The plans contemplate a roadway along the westerly edge of the lake, well above high water so as to allow future increase of reservoir capacity. This is the most important reservoir supplying San Francisco with water and all precautions must be taken for its purification. Extensive walls are required both to elevate the road above the lake and to prevent slides from the steep sand hill on the west. The right of way will be 70 feet wide for a length of 3,810 feet. Except for the section along the lake, two sidewalks are planned, varying from 12 feet to 6 feet in width. On the lake section, there will be but one walk 6 feet wide. Roadway varies from 50 feet at Lawton Street to 40 feet along the lake and 46 feet at Plaza Street near Forest Hill Station. Provision is made for a future main outlet from Sutro Forest to take care of traffic when this land shall have been subdivided for residential purposes. Estimated cost of Laguna Honda Boulevard, inclusive of present sewer construction contract, is $225,600.

Roosevelt Way is a boulevard 3900 feet long and 60 feet wide, extending from Fourteenth and Alpine Streets to Seventeenth and Clayton Streets. In the annual report for 1925-1926 it was noted that the grading and walls were completed and temporary paving laid. During the year, permanent paving has replaced the temporary pavement in all places, thus completing the paving of the entire boulevard.

Teresita Boulevard, 70 feet wide, extending from Portola Drive to Melrose Street in the Sunnyside District west of the proposed Glen Park Reservoir, a length of about 6200 feet, is not only a useful crosstown route but gives the Westwood Park vicinity a satisfactory route downtown via Market Street extension. About 3500 feet of this boulevard has already been dedicated to public use and the City holds deeds to the remainder. The northerly end connects to the constructed part of Laguna Honda Boulevard, which now terminates at Plaza Street near Forest Hill Station.

Merced Lands Panhandle—a connection between Alemany Boulevard and the boulevard proposed to encircle the Merced lands now being purchased by the City from the Water Company, has been projected along Stanley Street, from Junipero Serra Boulevard to Orizaba Avenue. An estimate of $200,000 has been made as the cost of the property to be acquired for the extension. The plans provide for a "Panhandle" connection 2400 feet long and 300 feet wide.

Golden Gate Park Panhandle Extension—an extension of Golden Gate Park Panhandle from Baker Street to Market Street near Duboce Avenue has been under discussion for years. This extension is highly

desirable as it would give a wide and almost level roadway to relieve the very heavy traffic that is constantly passing between Market Street and the Mission District on the east and Sunset and Richmond Districts on the west. Studies indicate that for this extension 4600 feet long and 200 feet wide, practically $3,000,000 will be required.

Miscellaneous Street Construction.

While the construction of boulevards occupies a more striking place in the public view, of no less importance is the paving of local streets.

In addition to the above enumerated major highway projects, there has been almost the usual volume of street development work throughout the City. The marked increase of work noted last year has been checked temporarily by the slight business depression but again the greater portion of the work has been in the southerly and southwesterly parts of town and in the residential areas west of Twin Peaks where the usual amount of pavement, sewer, sidewalks, etc., has been placed.

The most noticeable units are Noriega Street and Forty-seventh Avenue with some adjacent blocks, totaling 6500 lineal feet of pavement, and Twenty-eighth Avenue from Judah Street to Pacheco Street, with adjacent blocks, totaling 9000 lineal feet. These and other paving units through the sand dunes of the Sunset District are quickly reclaiming this desert for residential use. Added impetus has been given to the work of paving by the construction of the Westerly Sunset Sewer, Section B, which will be described elsewhere.

Development of single blocks of pavements and of sewers has been pronounced in the Lakeview District, the valley of Islais Creek from Ocean View to Mission Viaduct, and around the rapidly developing industrial area in the Bay View District. The completion of the widening and paving of Turk Street from Masonic Avenue to Willard Street has provided a very popular artery from the Western Addition to the Richmond District.

Widening Streets:

In addition to the new boulevard and highway construction, the facilities for handling traffic have been increased by the widening of many of the main streets and connecting arteries between districts. Additional traffic lanes have been added to the roadways by cutting down sidewalk widths.

The widening of **San Jose Avenue** to 80 feet, begun several years ago, has been completed. This avenue is now a favorite artery for Peninsular automobile traffic, much of which is now diverted from Mission Street.

A similar improvement on **Noriega Street** from Twenty-first Avenue to Forty-eighth Avenue has been carried on during the year. This street, traversing the center of the Sunset District on easy grades, was originally dedicated 80 feet wide and laid out for 50-foot roadway and 15-

Improvement Construction Under Way or Completed During the Year:	Length Ft.	Width Ft.	Approx Cost
Golden Gate Heights:			
Grading, Walls, Stairs, Macadam	4½ mi.	variable	$425,000
Peralta Ave., York to Montcalm:			
Grading, Walls, Macadam	1,000	60	33,000
Holladay Ave., Peralta to Adam:			
Grading, Walls, Pavement	800	60	15,000
Vermont St., 20th to 22nd Sts.:			
Grading, Walls, Macadam	1,210	80	35,000
Castro St., 29th to 30th Sts.:			
Grading, Walls, Macadam	1,000	112′ 6″	20,000
Florence St., Broadway to Vallejo:			
Walls,, Stairs, Pavement	275	30	7,000
Grand View Avenue:			
Grading, Walls, etc., complete, Paving, etc. Contract No. 2	2,350	44	38,000
Montgomery St., Green to Union:			
Grade, Pave, Sewers, Walls, Steps, etc.	275	62′ 5″	15,000
Pedestrian Underpasses:			
(2) Fleishhacker Pool			14,500
Plans Complete:			
Pedestrian Underpasses:			
Market St. in Congested Traffic Dist. (4)	125	8 x 12	135,000
Clayton St. Widening at Market St.			21,000
Burnside Ave., Bosworth to Chenery St:			
Pavement, Steps, etc.	212	60	7,760
Glen Park Terraces, Bosworth to Congo St:			
Pavement, Sewers, etc.			36,000
Ingerson Ave., Ingalls to Griffith St.:			
Pavement, Walls, Steps, etc.	1,508	80	19,000
Kingston St., Coleridge to Prospect Ave.:			
Pavement, Walls, Stairs, etc.	226	40	9,500
Montgomery St., Union to Greenwich:			
Grading, Walls, Stairs, etc.	687	64′ 9″	60,000
Santiago St., 12th to 14th Ave.	800	80	51,000
Paving, Sewers, Walls, etc.	200	70	
Twentieth St., Sanchez to Noe St.:			
Pavement, Sewers, Walls, Stairs	560	64	36,000
Valley St., Castro to Diamond St.:			
Pavement, Stairs	560	64	16,000
Corbett Ave., Clayton to 24th St.:			
Pavement, Walls, Stairs	3,800	50	100,000
Plans Being Prepared:			
Stanyan St. Widening, Oak to Frederick	2,100	90	no estimate
Coso Ave., Prospect to Winfield:			
Pavement, Steps, etc.			30,000
Monterey Blvd., El Verano to San Jacinto:			
Widening Roadways	1,200	80	26,000
Kezar Stadium Road: Pavement	2,000	60	60,000
States St., Castro to Levant:			
Elevated Sidewalks			8,000
Union St., Montgomery to Calhoun:			
Grading, Walls, etc.	240	68′ 9″	no estimate
Utah St., 18th to 19th St.:			
Pavement, Sewers, Stairs, Walls			20,000
Wolfe, Peralta & Mullen Ave. Intersections:			
Grading, Pavement			2,500

TRAFFIC SIGNS AND MARKERS

Traffic Engineering:

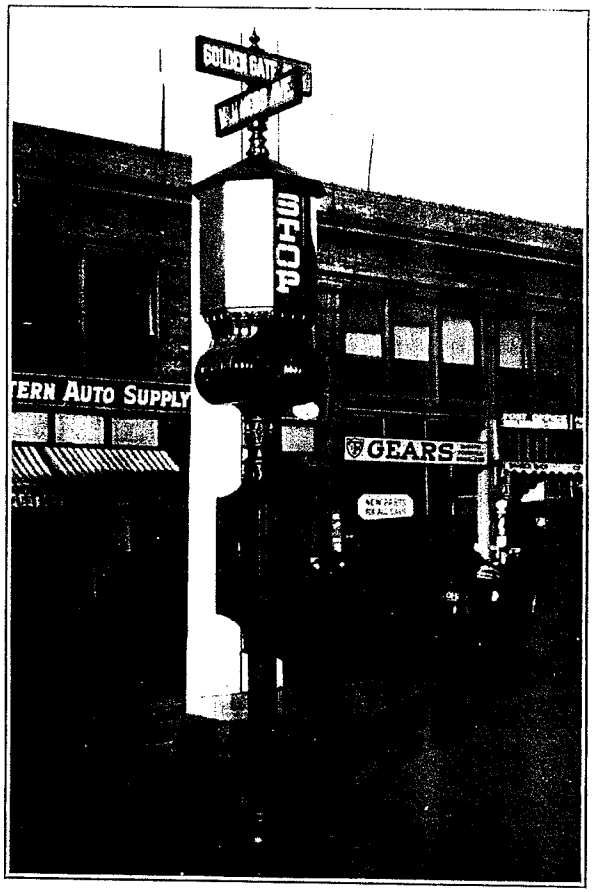
On April 24, 1926, the Mayor appointed the San Francisco Traffic Survey Committee to study traffic "in the hope of evolving constructive suggestions and thus bring about improved street traffic control in San Francisco." This Committee, supported financially by the business interests of the City, engaged a Street Traffic Research Engineer and after a year of study formulated a report on street traffic control. Ordinance No. 7691 (new series) embodying the results of their studies was finally passed September 6, 1927, and intelligent regulation of traffic began to supersede the previous haphazard methods.

One of the many recommendations of the report was, "There should be established a Division of Street Traffic Engineering of the Department of Public Works, . . ." In accordance with their recommendation the Supervisors on October 10, 1927, passed Ordinance No. 7753 (new series) creating a division of street traffic engineering under the jurisdiction of the Board of Public Works and forming a part of the Bureau of Engineering of the Department of Public Works. "The Division . . . shall consist of a competent traffic engineer who shall be known as the city traffic engineer, to be appointed by the said Board of Public Works, pursuant to law. . . . It shall be the duty of the city traffic engineer to conduct studies of street traffic accidents and congestion and of other conditions affecting the safe and convenient use of the streets; to collect facts regarding the effect and operation of regulations controlling street traffic and to plan with and otherwise assist the Police Department and Board of Supervisors in the placing, maintenance and operation of traffic signs, signals and markings, . . ."

G. D. Burr, of this department was appointed City Traffic Engineer. Under his direction studies are made of traffic conditions and remedies are proposed. The traffic division's recommendations have in every case been approved by ordinance. Many changes were made in the original traffic ordinance, the system of arterial streets has been modified, loading zones and no-stop zones have been located and improvements have been made on mechanical traffic aids. The division was called upon to recommend what streets should get preference in the annual street reconstruction program. Due to the dividing of responsibility and authority amongst the Board of Supervisors, Board of Public Works and Police Department, the work of the division is somewhat handicapped, but it is to be hoped that these conditions will be improved as the organization matures.

Traffic Markers:

During the year one contract for installing 60,000 Pedestrian Lane Markers was let for the estimated amount of $4,352. Bids were received



TRAFFIC SIGNAL
Standard "Stop" and "Go" sign surmounted by type "A" street sign

by the Board of Public Works on April 4, 1928. Recommendation was made on April 6, 1928, that the Supervisors appropriate $4,575 to cover the cost of the work and authorize the Board of Public Works to award the contract. On April 23, the Board of Supervisors awarded the contract to E. J. Treacy. To date, due to failure of the Board of Supervisors to appropriate the moneys requested, work has not been begun.

Specifications are being prepared for wiring 500 existing arterial stop signs, which hitherto have not been illuminated. The estimated cost of this work is $60,000.

Specifications were prepared and bids received April 16, 1928, for 1000 traffic turning buttons, but owing to lack of funds the contract has not been let.

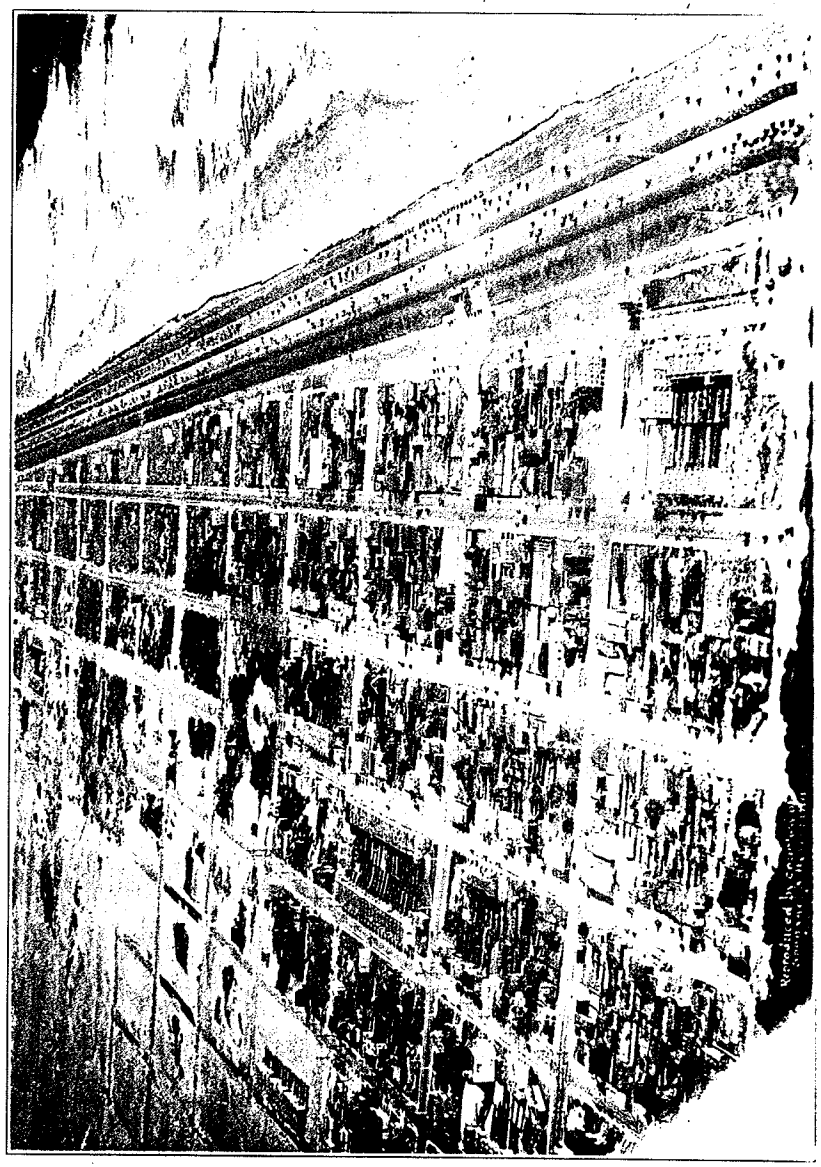
Street Signs:

The erection of street signs has continued systematically in accordance with the plans outlined in former years. Since the standardization of signs the City has placed 3,434 type "A" and 660 type "B" signs. The type "A" sign consists of a 3-inch standard galvanized iron pipe about 9 feet high set in concrete base and surmounted by cast aluminum frames 7 3/8 inches by 22 5/16 inches holding four name plates. The plates are of pure iron on which are enameled white letters 3 inches high on blue background. The front of the plate has five coats of protective porcelain enamel, the back, two coats. Cast iron caps and top piece of the frame are heavily galvanized. The type "B" sign consists of a single name plate on redwood backing and is set on a building or similar improvement, at the smaller streets or alleys. Type "A" signs are set generally one at an intersection, but on the wider and more important streets, two or sometimes four signs are used.

During the year 539 type "A" and 82 type "B" signs were set. The streets in the older settled portions of the City have been generally well marked and the extensions of sign work are now being made largely in the new additions. The latest contracts have covered the placing of signs in the Ocean View District, Golden Gate Valley, Richmond District, the new residential areas west of Twin Peaks and Mt. Davidson and parts of the 100 Vara and Mission Districts.

It is planned during the new fiscal year to place 250 type "A" standards in Sunset, Western Addition, Sunnyside, Mission and Excelsior Districts, to place signs on top of all "Stop" and "Go" traffic signals and to repair and repaint existing standards.

For installation and maintenance of street signs, $10,000 per year is available.



REPORT

OF THE

BUREAU *of* ENGINEERING

OF THE

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF
SAN FRANCISCO

FISCAL YEAR ENDED JUNE 30, 1929

JAMES ROLPH, Jr. . . . *Mayor*

TIMOTHY A. REARDON
CHARLES E. STANTON
FRED W. MEYER
Board of Public Works

M. M. O'SHAUGHNESSY
City Engineer

The asphaltic concrete wearing surface consists (by weight) Asphaltic cement, 6% to 8%; mineral aggregate, consisting of [illegible] stone or gravel, sand, and stone dust, 94% to 92%.

Both binder and wearing surface are spread with a mechanical spreader with a raking attachment. Rolling is done with a 3-wheel 12-ton roller followed by an 8-ton tandem roller. The finished surface must be true and uniform, with no rolls or depressions in any part exceeding ¼ in. from the true grade and cross section of the finished strip.

Conduits for lighting standards and traffic signals, and public utility pipes and ducts are being laid now to avoid tearing up the pavement in future. Erection of electroliers has come to a decided stop due to deliberations of the Supervisors, who questioned the type selected by the City Engineer.

Pedestrian subways are being constructed on the more important boulevard intersections. Locations are determined by this office after consultation with the Police Department, the Board of Education and other interested public bodies.

Two types of construction are used—a standard section for crossing under ordinary streets, and an extra heavy section for use under steam railroad tracks.

The standard subway is a tunnel 6 ft. wide by 7 ft. 3 in. high, reached by stairways 5 ft. wide located within the sidewalk lines. The stairways with its balustrades, would be a serious encroachment on the sidewalk area, especially where the width of the sidewalk is 12 ft. or less. In some cases, additional width has been obtained by the purchase of a few feet of land. In one case, the use of different curvature at the property line and at the curb line, gave sufficient additional width.

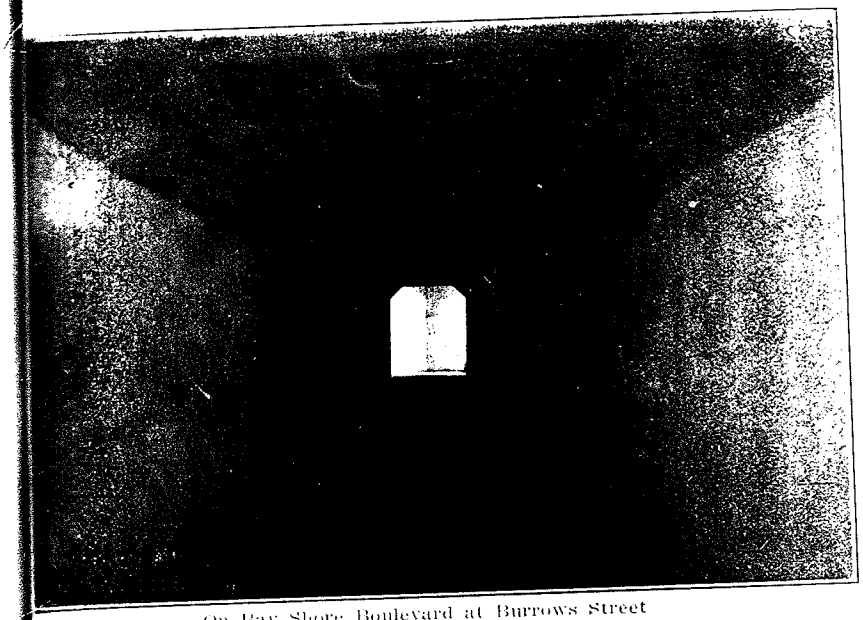
The most desirable depth is with the floor at 11 ft. below curb grade. This requires special diversion of sewer lines, one method being an effort to pass around the stairway, within the sidewalk area.

Drainage of the subway is either direct to the sewer or to a small sump from which the accumulated water may from time to time be drawn off to a sewer by use of an ejector operated either electrically or from the city water pipe.

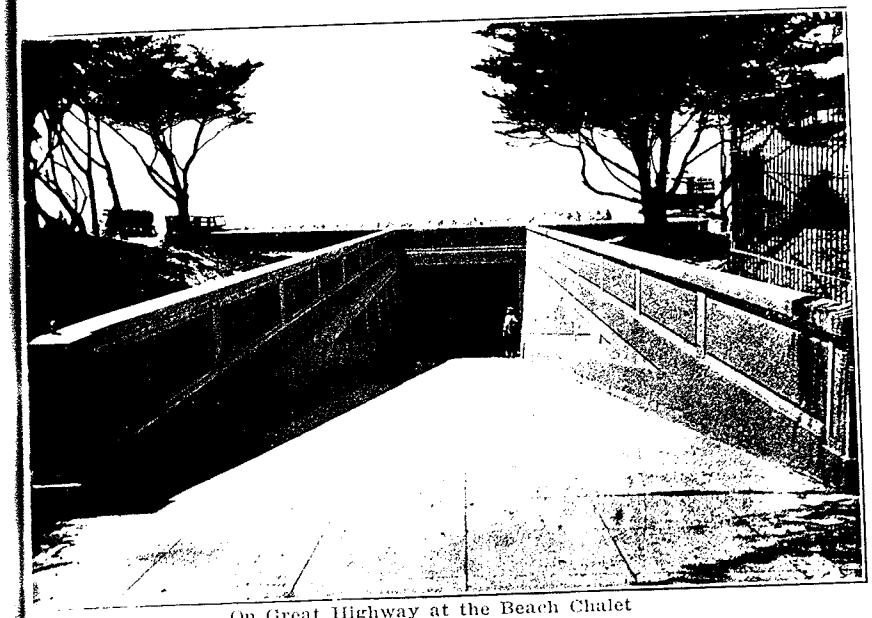
Water, gas, and electric conduits pass through the space between the top of the subway and the bottom of the pavement.

Lighting is by lamps set in recesses at 20 ft. intervals on both sides of the subway. A special device is used to minimize danger of pilferage.

Bay Shore Boulevard extends from Potrero Avenue to the County line, a distance of 3.01 miles. Part of the location is along former streets which have been widened and straightened. The new roadway is 100 ft. in width. There are also two sidewalks 12½ ft. wide. Although most of the grades are very flat, an 8 per cent grade was necessary in climbing

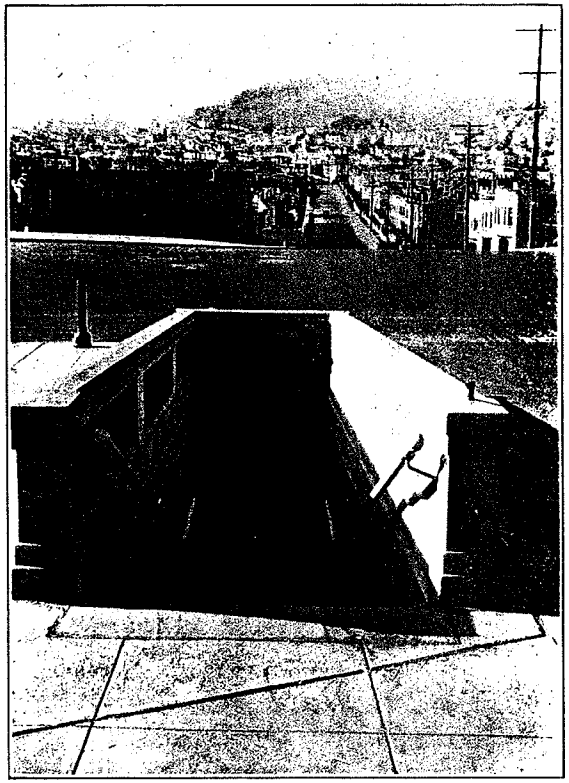


On Bay Shore Boulevard at Burrows Street



On Great Highway at the Beach Chalet

PEDESTRIAN SUBWAYS



PEDESTRIAN SUBWAY
On Alemany Boulevard at Santa Rosa Avenue

the hill south of the Islais Creek crossing. The City's work was divided for construction purposes into 5 units, called Sections A, B, C, D, and E.

Section A is 6000 ft. long from Potrero Avenue to Silver Avenue. About 77 per cent of the work under the contract let in June, 1928, has been completed. A temporary pavement has been placed where the subgrade is liable to settlement. The new boulevard follows for some distance the line of San Bruno Avenue, one of the main outlet streets of the City. This avenue has been widened and straightened, and the street railway tracks have been relocated and reconstructed. This latter work proved particularly difficult and resulted in considerable delay. The new boulevard is in use continuously.

Section B follows the line of Charter Oak Avenue from Silver Avenue to Paul Avenue, a distance of 3719 ft. The work was completed February 21, 1929.

Section C extends diagonally through the blocks of built-up resi

Bay Shore Boulevard. A 52-foot cut, 125 feet wide

Bay Shore Boulevard. End of Sec. B and beginning of Sec. C, showing improvements to be removed

BOULEVARD CONSTRUCTION

dential sections 2119 ft. from Paul Avenue to Third Street. The acquisition of the necessary properties delayed the receipt of proposals until April 3, 1929. The contract was awarded on April 8 to Municipal Construction Company for the estimated amount of $74,123.30, and work is being carried on under a schedule calling for completion by October 1. To date 7 per cent of the work is completed.

Section D, extending 1600 ft. from Third Street to Tunnel Avenue, involves the grading of 200,000 cu. yds. of rock; the maximum depth of cut is 52 ft. The contract was awarded on August 27, 1928, to Granfield, Farrar, and Carlin, for the estimated amount of $212,805.66. The work is now 88 per cent complete.

Section E is 2500 ft. in length from Tunnel Avenue to the San Mateo County line. Immediately following the acquisition of the necessary properties, contract was awarded on February 11, 1929, to Federal Construction Company for the estimated amount of $107,115.38, and the work is now 35 per cent complete. Relocation of street car tracks is necessary here, as was the case in Section A.

Alemany Boulevard extends 4.8 miles from Bay Shore Boulevard near Cortland Avenue to Junipero Serra Boulevard near the County line. It occupies the right of way of the former Ocean Shore Railway, which discontinued operations several years ago. This right of way originally 60 ft. wide, was purchased by the City and was increased to 100 ft. to widen the roadway. The boulevard has an 80-ft. roadway and two 10-ft. sidewalks.

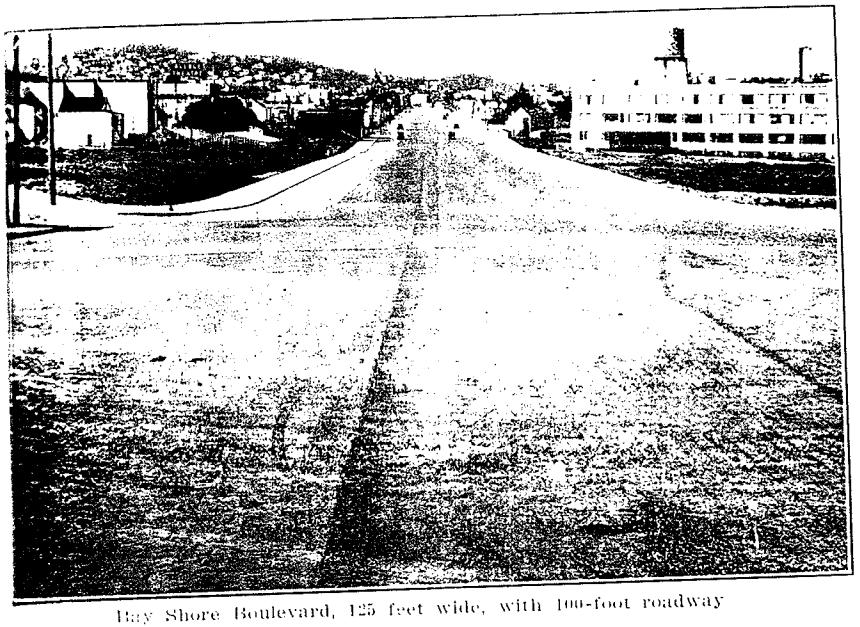
Three pedestrian subways are being constructed. At Mission Street the viaduct completed in 1911 provides complete grade separation between the two main arteries.

For construction purposes, the boulevard has been divided into six units: A, B, C, D, D1, and E.

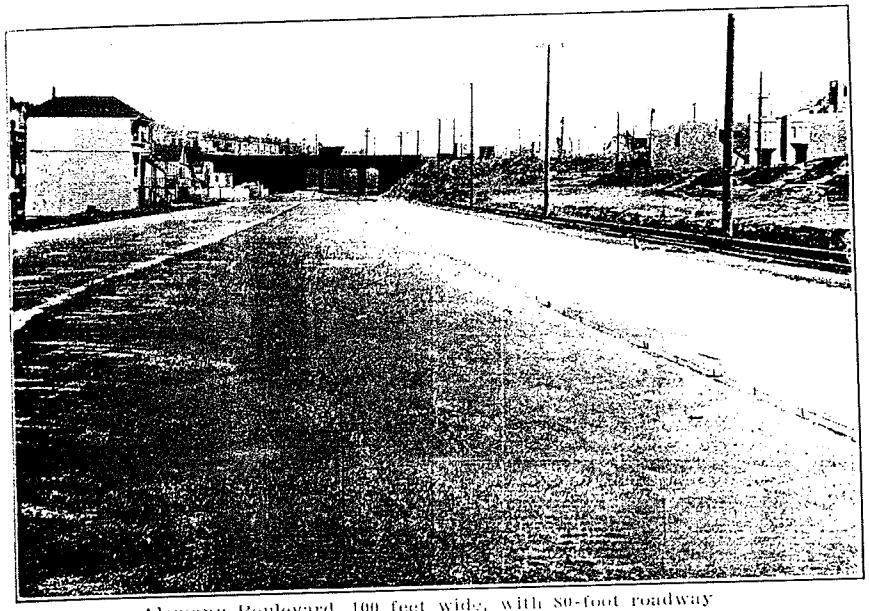
Section A extends 7100 ft. from Bay Shore Boulevard to Mission Street. Plans for this section are prepared, and all purchases of rights of way are completed, but construction cannot be begun until certain sewer work shall first be done.

In the annual report for the fiscal year 1927-28, note was made of the necessity for a bond issue for construction of a main sewer along this boulevard. The issuance of 4½ per cent sewer bonds was authorized in the election of November 6, 1928, but, owing to the condition of the bond market, no bonds have yet been sold. It is planned to sell, at an early date, enough sewer bonds to carry on this construction, thus allowing the boulevard work to proceed.

Section B, from Mission Street to Ocean Avenue, is 3900 ft. long. Work under the contract awarded to Eaton and Smith on March 10, 1928, was finally completed in March, 1929, although it had been conditionally accepted in January.



Bay Shore Boulevard, 125 feet wide, with 100-foot roadway



Alemany Boulevard, 100 feet wide, with 80-foot roadway
Mission viaduct in background

COMPLETED BOULEVARDS

Section C, from Ocean Avenue to San Jose Avenue, is 7800 ft. long. About 65,000 cu. yds. of waste from the Bernal Cut has been used to fill the low areas. Property acquisitions, reported last year as in progress, have now been completed, and at an early date a contract should be let for grading, paving, construction of concrete walls and curbs, and for alteration of some existing sewers.

Section D and D1 are alternate routes from San Jose Avenue to Orizaba Avenue. The direct route, Section D, is 1630 ft. in length. Grade separation at the Southern Pacific Railroad will be very expensive, so the alternative route D1 will be used until the increase of crosstown traffic on Plymouth Avenue makes advisable the construction of the direct route. Contract for this section was awarded on September 12, 1928, to Hanrahan Company for the estimated amount of $49,884.12, but the right of way acquisition is not yet complete, and the work has not begun. One parcel could not be purchased amicably, so condemnation proceedings were resorted to. The jury set a value far in excess of the City's appraisal so the City declined to purchase. Negotiations in progress indicate that the land may be bought at a price substantially less than that set by the court.

Section E is 2710 ft. long from Orizaba Avenue to Junipero Serra Boulevard. The initial contract awarded to Granfield, Farrar and Carlin, signed on August 31, 1928, which included grading, sewers, and permanent paving of half the roadway, was completed in May, 1929. In the meantime, the fill which constituted the other half of the roadway had become sufficiently compacted so that final contract was let on April 29, 1929, to Federal Construction Company for the estimated amount of $28,907 for paving and construction of curbs. Work was begun in June and is now 32 per cent complete.

Junipero Serra Boulevard extends from the intersection of Sloat Boulevard and Portola Drive, a distance of 1.8 mi. This has been one of the most popular routes connecting to both Skyline Boulevard and El Camino Real, but traffic has been throttled by the narrow 25-ft. pavement. Reconstruction of this boulevard will provide a 100-ft. roadway and two 12½-ft. sidewalk areas. Negotiations with Spring Valley Water Company for rights of way for this boulevard and also for the Nineteenth Avenue Extension were protracted. It was not until March 25, 1929, that contract was awarded to Eaton and Smith for the estimated amount of $347,396.50. The contractor's schedule calls for completion of the work by February, 1930. At present 4 per cent has been done.

Junipero Serra Boulevard Extension begins at the county line and extends southerly and southeasterly into San Mateo County. This construction is financed by Joint Highway District No. 10, in which San Francisco assumes 85 per cent and San Mateo County 15 per cent of the cost. Its object is the development of a new and independent highway to Santa Clara County, following the route of Alameda de las Pulgas in the low hills back of Atherton and Redwood City. The construction of this highway and the further extension of the Bay Shore Highway will relieve the congestion of the present State highway, El Camino Real, which recently showed a traffic count of 30,000 vehicles in 16 hours.

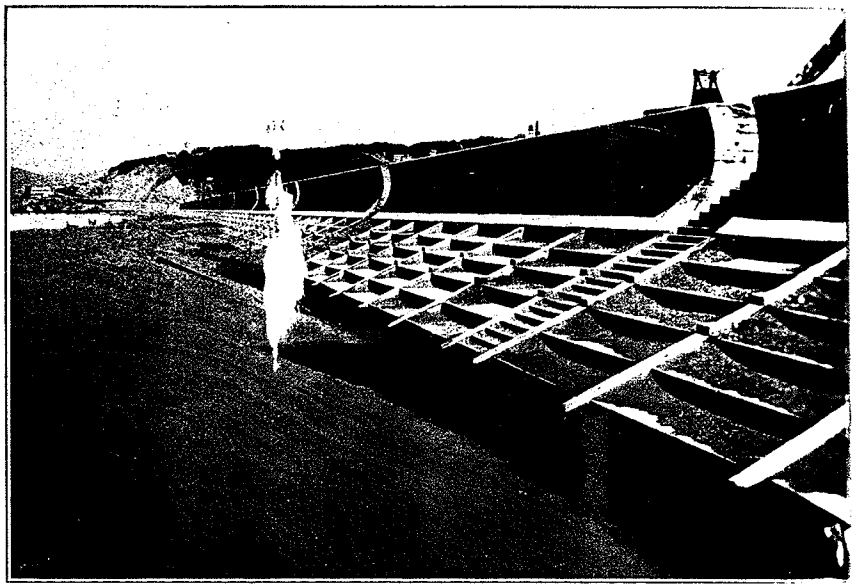
The first link of this extension, known as "Unit A," from the county line to School Street at Colma, is 1.1 mi. in length. Plans and specifications for the construction of Unit A have been prepared in this office, and it is expected that bids will be called for within 60 days. The intention is to provide a 125-ft. right of way, and for the present to grade it to full width and construct initially a 60-ft. roadway, consisting of an 8-in. water-bound macadam base with 1½-in. oiled macadam or 2-in. asphalt top. Shoulders of water-bound macadam 4 in. thick and 10 ft. wide, concrete gutters 5 ft. wide, and on the west side an oiled macadam walk 5 ft. wide will also be built.

Unit B, extending from School Street to the Colma-San Pedro Road, a distance of ⅔ mi., will be constructed subsequently as soon as funds are available, the expectation being that this will be within one year. Construction of other units will follow as quickly as possible.

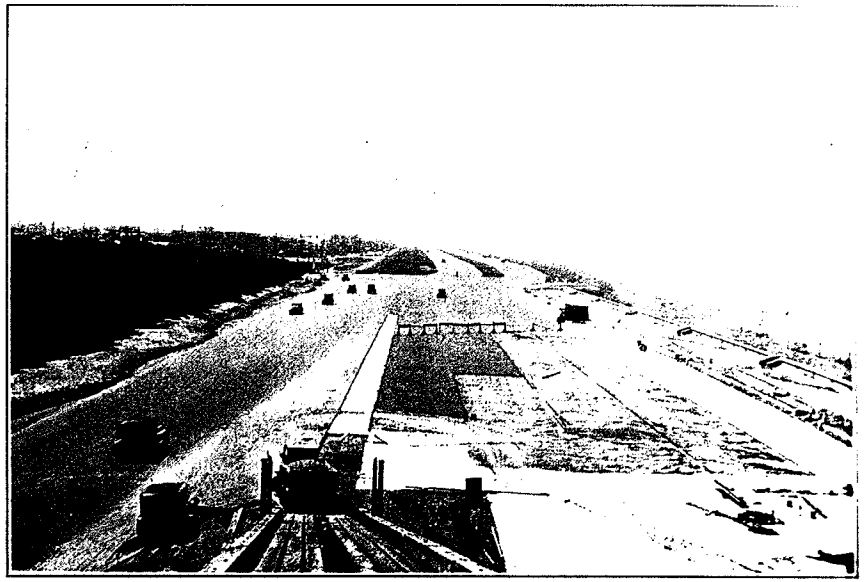
Nineteenth Avenue Extension from Sloat Boulevard to Junipero Serra Boulevard at Worcester Avenue, a distance of 1.3 mi., was delayed also by negotiations for rights of way from the Water Company. Contract was awarded on February 25, 1929, to Eaton and Smith for the estimated amount of $257,142.60, and the work is now 22 per cent complete. The contractor's schedule calls for completion by November, 1929. The roadway will be 80 ft. wide from Sloat Boulevard to the intersection with the Municipal Railway. From this point there will be a 44-ft. roadway on each side of the 32-ft. railway right of way. There will be two 10-ft. sidewalk areas for the entire length of boulevard. On each of these, as in the Junipero Serra Boulevard, there will be a 6-ft. stone sidewalk and an area planted to veronica and ice plant.

Sunset Parkway is what was formerly the block between Thirty-sixth and Thirty-seventh Avenues, 240 ft. wide and 2.1 mi. long from Golden Gate Park to Sloat Boulevard. Although the original intention was merely to purchase the lands for this boulevard out of the present bond funds, savings effected may be sufficient to finance also the construction of a portion of this highway. At present about 75 per cent of the lands required have been purchased.

Ocean Beach Esplanade is the broad highway and parking space along the ocean beach frontage, reaching from the bluffs south of the Cliff House to the southerly line of Golden Gate Park, a distance of 4298 ft., of which 2232 ft. were completed during this fiscal year. Two walks 20 ft. wide, a 15-ft. lawn, and a roadway varying in width from 188 ft. to 199 ft., are protected from erosion by the waters of the Pacific Ocean by erection of a concrete seawall. Rising from the sand beach are stepped, reinforced



Concrete Seawall and Bleachers



Roadway 200 feet wide, 20-foot sidewalks, and lawn
Great Highway in background
OCEAN BEACH ESPLANADE

concrete bleachers. Back of these is the sea wall proper, its shape so designed as to check the ocean waves gradually and then turn them back without splashing or inundating the esplanade.

The work done this year is a continuation of various installments begun in 1914. Prior to that time, the Great Highway, as the shore boulevard is known, had been washed away fr[om] time to time by giant breakers during great storms. Some protectio[n] had been afforded the Beach Chalet by a barrage of piles driven in t[he] sand beach under the direction of the Park Commission, but the line [of] piles was very unsightly and of doubtful utility.

Before undertaking construction of the [e]splanade sea wall, this office made extensive studies of sea protective [wo]rk in the United States and in Europe. There have been many failures [o]f such work previously constructed, but although the conditions here are difficult, largely on account of the sand foundation which extends to a depth of at least 200 ft., it is felt that we now have an adequate, permanent wall, which is both useful and ornamental.

Two contracts were awarded to Healy Tibbitts Construction Company for this work, one covering the general construction, which has already been completed, and one the paving which is 54 per cent complete and should be finished by August, 1929.

Great Highway from Golden Gate Park to Sloat Boulevard, 2 mi. in length, has been completed to form a most beautiful boulevard. The

GREAT HIGHWAY
Two Miles of Double 50-Ft. Roadway, separated and bordered by lawn and shrubbery, and one mile of broad esplanade and boulevard to the Cliff House

development consists of two 50-ft. roadways, separated by a 25-ft. parked area, with walks, bridle path, ornamental shrubbery, and lawn as described in the annual report for the preceding fiscal year. Pedestrian subways are provided at the more important crossings to allow free access to the ocean beach. Great Highway and Esplanade, extending a total distance of almost 3 miles, with widths from 250 to 324 ft., constitute one of the finest boulevards in the country and afford thousands of people opportunity to view the inspiring beach of the Pacific Ocean.

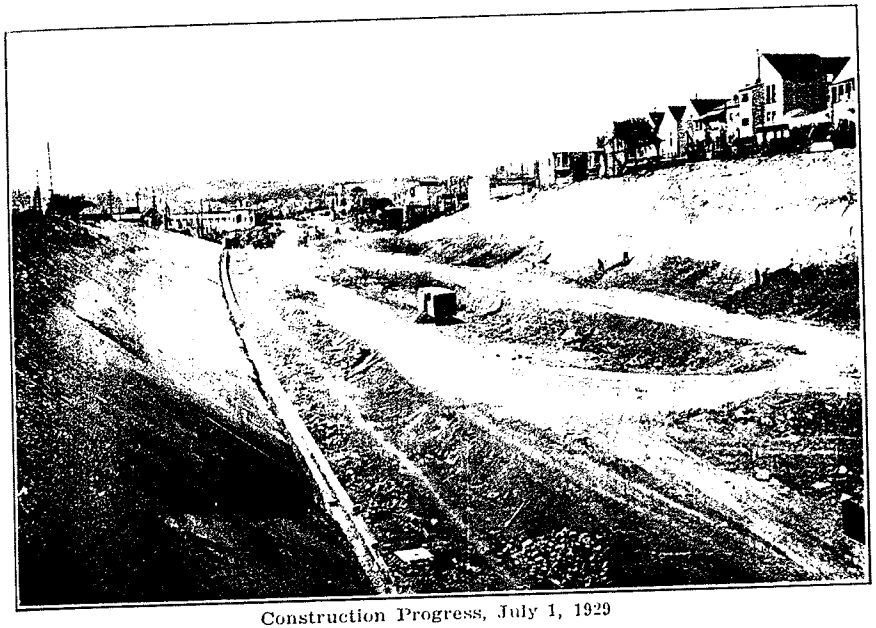
Contract was awarded on July 16, 1928, to Granfield, Farrar and Carlin for the estimated amount of $131,121, but in September, 1928 a change to permanent type of pavement increased this amount to $225,198.25. The work was completed in April, 1929, but was not immediately thrown open to public use, as the Supervisors were dissatisfied with the electroliers specified by this office. Formal opening and dedication was held on June 9, 1929.

Van Ness Avenue Extension is the last item of the $9,380,000 boulevard bond program. It contemplates the extension of Van Ness Avenue South from its present terminus at Mission Street, diagonally to Howard Street at Thirteenth Street. This is preliminary to the development of Howard Street as a boulevard, and will produce a north and south artery 4 mi. long from Twenty-sixth Street to the bay at the foot of Van Ness Avenue.

The City Engineer's plan for a straight extension met with considerable opposition from some supervisors who, on the plea of economy wished to introduce some bends in alignment, but eventually the original straight plan was adopted. Some parcels of land have been acquired but the remainder will have to await the marketing of additional bonds.

Bernal Cut Boulevard construction is proceeding expeditiously although the contractor is somewhat behind the time schedule. After a delay by the Board of Supervisors' failing to authorize the Mayor to enter into an agreement with the Southern Pacific Company for exchange of lands, contract was awarded on October 3, 1928, to MacDonald and Kahn for the estimated amount of $504,829.39, including demolishing the old Bosworth Street bridge, building new bridges at Highland Avenue, Richland Avenue, and Bosworth Street, excavation, and constructing sidewalks, fence, sewers, and rubble walls. This contract is now 25 per cent complete. The schedule calls for completion by April, 1930. The Supervisors, on request of some interested property owners, directed that a vehicular bridge, instead of one for pedestrian use, be built at the Richland Avenue crossing.

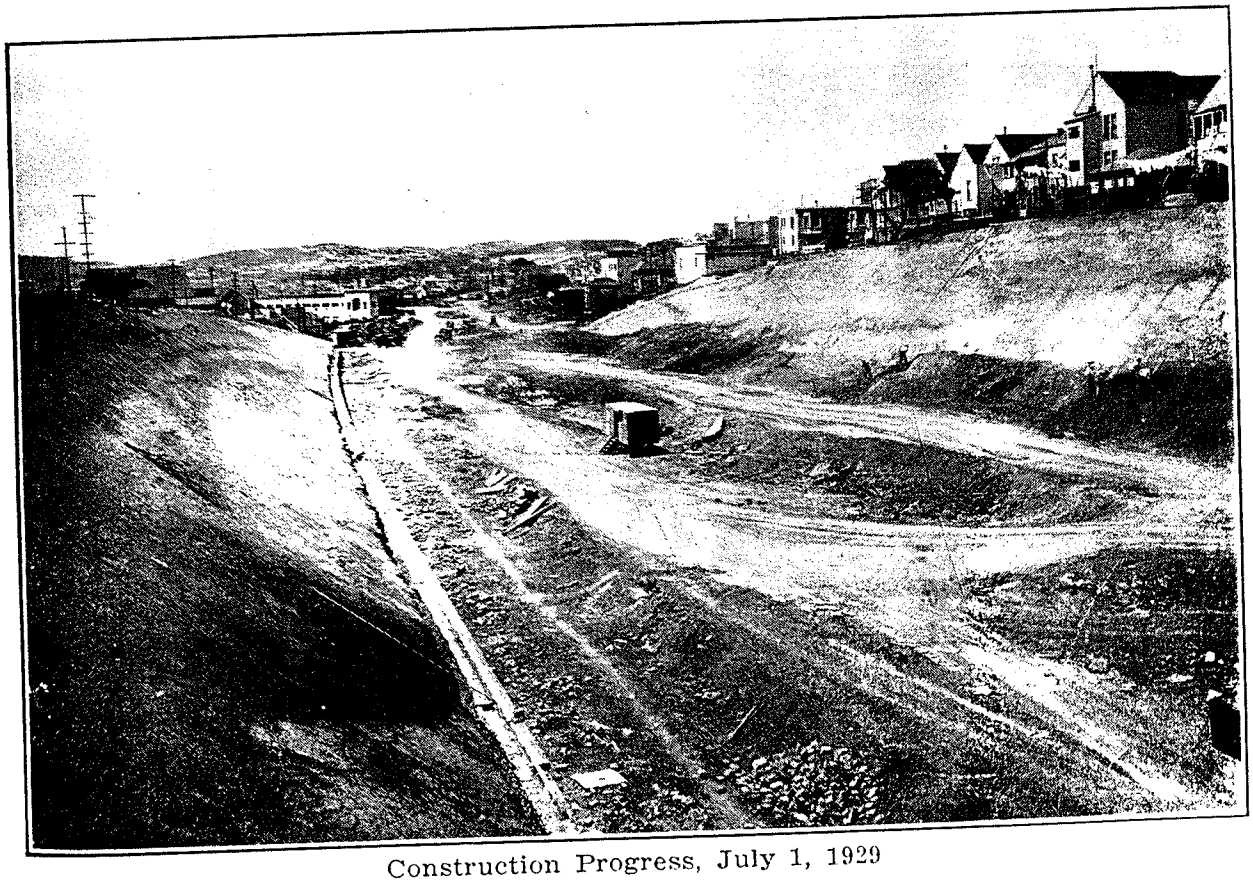
Railroad Cut before widening to 117½ feet for boulevard, railways and walks



Construction Progress, July 1, 1929

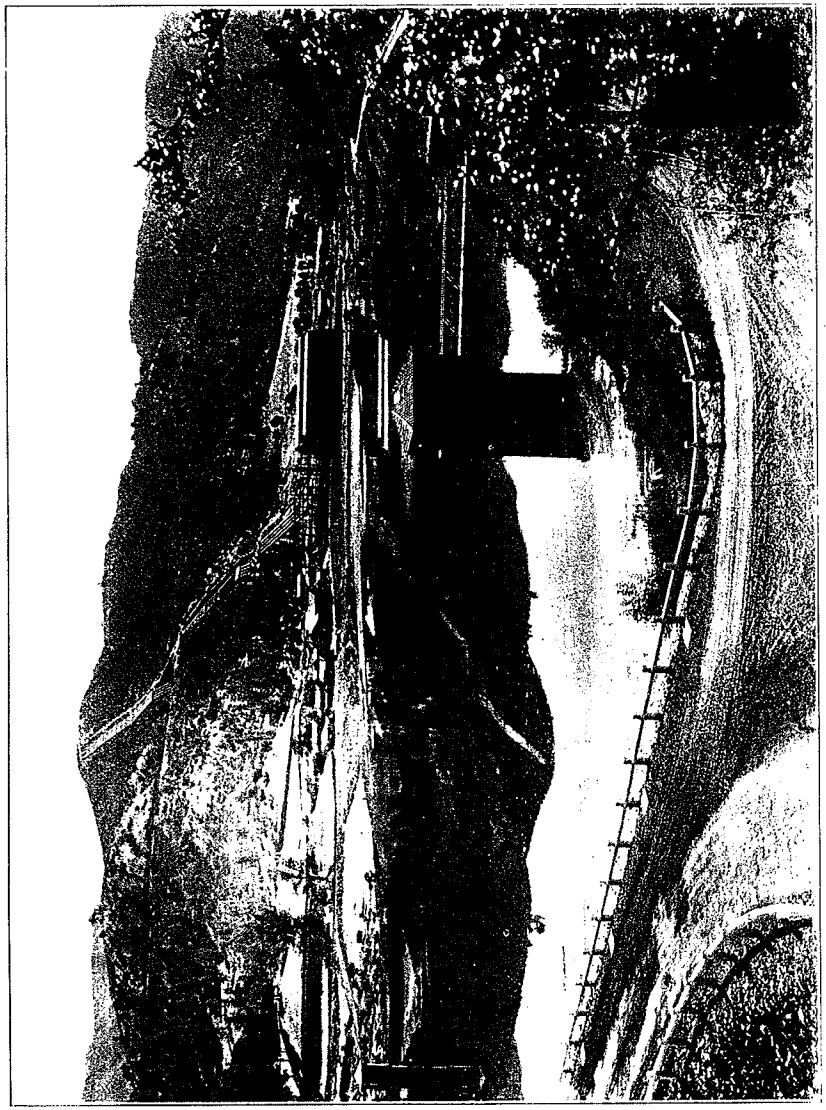
BERNAL CUT

Railroad Cut before widening to 117½ feet for boulevard, railways and walks



Construction Progress, July 1, 1929

BERNAL CUT



MOCCASIN

General view of village from Mount Tam

ANNUAL REPORT

OF THE

BUREAU OF ENGINEERING

OF THE

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF
SAN FRANCISCO

FISCAL YEAR ENDED JUNE 30, 1931

ANGELO J. ROSSI . . . *Mayor*
TIMOTHY A. REARDON
CHARLES E. STANTON
WILLIAM H. WORDEN
Board of Public Works

M. M. O'SHAUGHNESSY
City Engineer

Compliments of
M. M. O'Shaughnessy,

ORGANIZATION AND PERSONNEL—(Continued)

C. M. Taylor.....Assistant Engineer
Supervising Major Local Construction, Boulevards, etc.

F. J. Sheehan.....Assistant Mechanical Engineer
Supervising Street Railway Construction and Maintenance

L. Glick.....Assistant Engineer
Contract Payments, Payrolls

C. R. Rankin.....Construction Engineer
Supervising Construction of Coast Range Division of Hetch Hetchy

L. A. McAtee.....Construction Engineer
Supervising Construction of San Joaquin Pipe Line of Hetch Hetchy

Thornton Easler.....Assistant Electrical Engineer
Supervising Power Operation of Hetch Hetchy

Willis O'Brien.....Auditor
Hetch Hetchy Water Supply, Accounting and Payrolls

Retirement

Retired for Service:

I. J. Ohman, Assistant Civil Engineer.....March 1, 1931

Report of the Bureau of Engineering

DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF SAN FRANCISCO

1930 - 1931

BOULEVARDS, STREETS, AND HIGHWAYS

Boulevard Construction Out of Bond Issues:

As was noted in the Annual Report for the fiscal year 1929-1930, construction of the boulevards under the bond issue authorized in 1927 had then come to such a stage that seven of the nine projects authorized were in use. During the past fiscal year all of the remaining sections of Alemany Boulevard, except one, have been thrown open to public use, and satisfactory progress has been made in the purchase of lands necessary for the completion of the extension of Van Ness Avenue from Mission Street to Howard Street. Sunset Boulevard is now open for traffic for almost its entire length and its completion is expected within a short time. On a number of the new boulevards the temporary pavement, which was laid on sections of subgrade liable to settlement, is now ready to be replaced by permanent pavement.

The lower roadway of Great Highway has been permanently paved for its entire length of two miles from Lincoln Way to Sloat Boulevard.

The long standing controversy about type of electroliers for use on boulevards has been settled, as will be noted in the article "Boulevard Lighting Standards."

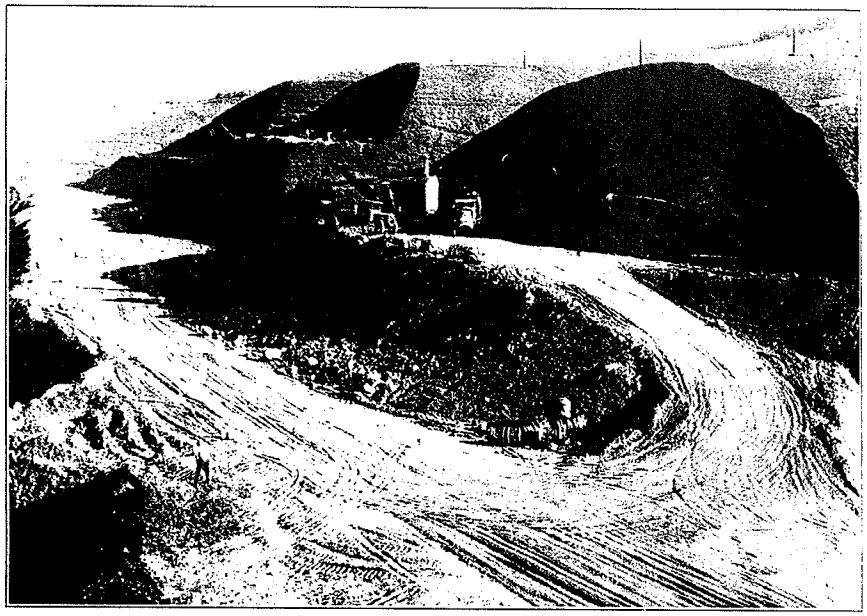
The status of construction of boulevard projects under bond issues is as follows:

Bay Shore Boulevard 3.01 miles long, from Potrero Avenue to the County line, with 100 ft. roadway and two 12½ ft. sidewalks is complete and open to traffic. In some portions of this boulevard there is temporary pavement which later will be replaced by permanent pavement.

Alemany Boulevard extends along the old right of way of Ocean Shore Railway from Bay Shore Boulevard up the valley of Islais Creek, over the summit at Ocean View to Junipero Serra Boulevard, a distance of 4.8 miles. The boulevard consists of an 80 ft. roadway and two 10 ft. sidewalks.

Section A extends 7100 ft. from Bay Shore Boulevard to Mission Street Viaduct. During the year the storm drain in this roadway, which was noted under construction in last year's report, was completed, as will be noted under "Sewers." This was followed by grading of roadway and laying of temporary pavement on top.

Section B from the viaduct to Ocean Avenue, 3900 ft. in length, was noted last year as completed. However a contract will soon be let for



ALEMANY BOULEVARD, SEC. A

construction of the portion beneath and immediately adjacent to the Mission Viaduct.

Section C, 7800 ft. long, from Ocean Avenue to San Jose Avenue at Plymouth Avenue, is still incomplete. It has been deemed advisable to allow the fill to settle further before pavement is laid. A portion of this section, however, will receive permanent pavement under a contract for which bids are to be received July 15, 1931.

Of the alternative sections, D and D-1, from San Jose Avenue to Orizaba Avenue, respectively 1630 ft. and 2192 ft., construction is still being withheld on the former, while the latter is complete.

Section E, from Orizaba Avenue to Junipero Serra Boulevard, has already been noted as complete.

Junipero Serra Boulevard, 1.8 miles in length, from Sloat Boulevard to San Mateo County line, consists of a 100 ft. roadway and two 12½ ft. walks. This boulevard is complete and serves a very useful purpose in providing an outlet from the city connecting with the main state highway, El Camino Real, which leads to all points south.

The southerly extension of this boulevard into San Mateo County will be discussed under "Joint Highways."

Nineteenth Avenue Extension, 1.3 miles in length, from Sloat Boulevard to Junipero Serra Boulevard at Worcester Avenue, was noted as complete last year.

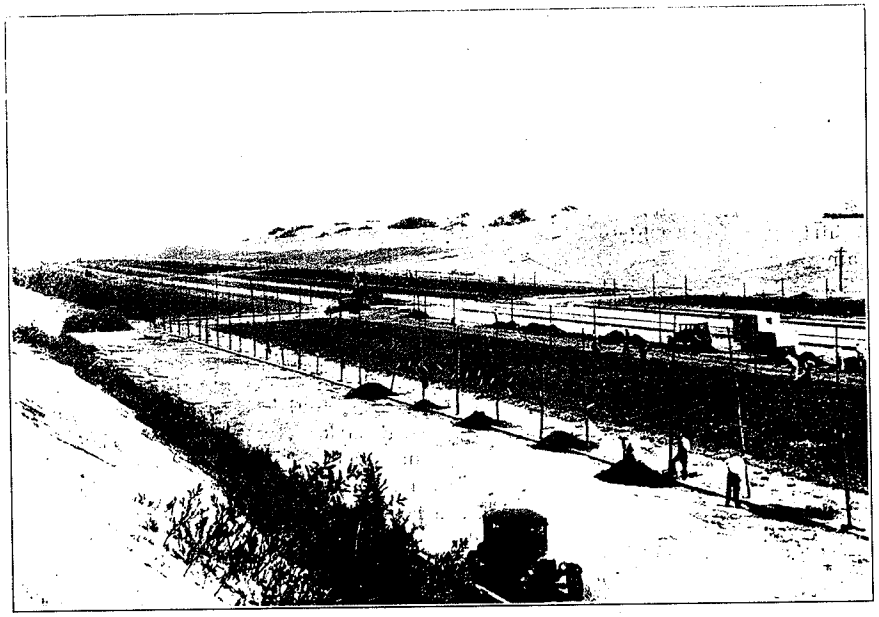
Sunset Boulevard occupies the entire block 240 ft. in width between Thirty-sixth and Thirty-seventh Avenues. The boulevard is centrally located, 2.1 miles in length, from Lincoln Way at Golden Gate Park to Sloat Boulevard. A southerly extension .4 mile in length, leads to a junction with the boulevard around Lake Merced, a portion of which has been completed, as will be noted under "Road and Boulevard Work to Relieve Unemployment."

The boulevard has been divided into five sections, A, B, C, D and E, to facilitate construction work.

Section A extends from Lake Merced Boulevard to Yorba Street, a distance of 1500 ft. The construction was undertaken by crews mobilized to relieve unemployment. Clearing of extensive groves of eucalyptus trees has been almost completed and a small amount of grading has been done. It is planned to discontinue work very shortly.

On May 20, 1931 twenty-one bids were received for construction of Sloat Viaduct. These ranged from $169,339.70 to $115,133.11, the lowest being that of Mission Concrete Company, to whom the contract was awarded. The work is now being laid out. This viaduct is of the most modern type and provides a cloverleaf grade separation, Sloat Boulevard being carried over Sunset Boulevard.

Section B extends 3400 ft. from Yorba Street to Santiago Street. Contract was awarded to Meyer Rosenberg on September 10, 1930 in the



SUNSET BOULEVARD

estimated amount of $83,766.00. The contractor expects to complete the work on July 7, 1931.

Section C extends from Santiago Street to Noriega Street, a distance of 3400 ft. Contract for its construction was awarded to California Construction Company on October 8, 1930 in the estimated amount of $103,-844.00. It is expected that the work will be completed during July, 1931.

Section D from Noriega Street to Irving Street, a distance of 3400 ft., is under construction by California Construction Company, to whom a contract was awarded September 24, 1930 in the estimated amount of $104,-276.00. Completion of this work is expected within the next few days.

Section E extends from Irving Street to an intersection with South Drive in Golden Gate Park, a distance of 1000 ft. There will be a grade separation by means of concrete viaduct at Lincoln Way. As a preliminary to this viaduct construction it is necessary to divert the Lincoln Way sewer, which at this point is 6' 6" circular. This work is now under construction and will be noted under "Sewers." Plans are completed for the viaduct.

Provision has been made so that the roadways may be widened to 50 ft. in the future. The roadways are edged with unarmored concrete curbs. The minimum radius of curb returns is 25 ft. The roadway pavement consists of 2½ inch asphaltic concrete wearing surface on a 10 inch waterbound macadam base constructed in two 5 inch courses. The asphaltic concrete wearing surface is spread and finished with a mechanical spreader. The 15 ft. pedestrian path is paved with 4 inch waterbound macadam edged with redwood headers. The equestrian path is similar to the walks except that the waterbound macadam pavement is 6 inches in thickness.

The parking area, which is being developed under direction of the Park Commission, is covered with 8 inches of loam and 1½ inches of manure.

The boulevard traverses the undeveloped sand dunes near the ocean beach, where heretofore considerable difficulty has been had from drifting sands. As a defense against encroachment of sands the cut slopes along Thirty-sixth and Thirty-seventh Avenues are sown with barley seed in the amount of one pound to 600 square feet and then covered by using a light harrow or a brush drag. The sown area is then covered with hay, loosely spread, using one ton per ten thousand square feet. A small amount of sand is spread on the hay at frequent intervals. This method of prevention of sand drifts has been quite successful in other places in the sand dunes.

Conduits have been installed for the traffic signal system and electroliers for lighting will be erected along the central park strip at intervals of 115 ft.

A pipe and sprinkler system was installed under one contract, which was let after the grading contracts. A 4 in. water main extends along the center line for the entire length of the boulevard. Risers from this, which reduce eventually to ¾ in. pipe, lead to lawn sprinklers and to an occasional drinking fountain.

The cost of land acquisition for Sections B, C, D and E was approximately $1,500,000. The land for Section A was acquired by the City in the purchase of the Spring Valley Water Company system.

In the block between Lincoln Way and Irving Street it was necessary to purchase and remove 28 dwellings.

The construction of Sunset Boulevard has stimulated public activity in the region adjacent to the work and a great many residences are now under construction.

Ocean Beach Esplanade was noted in last year's report as completed. This provides a paved and parked area 4298 ft. in length along the Ocean Beach frontage from the Cliff House southerly past Golden Gate Park.

Great Highway extends from Golden Gate Park to Sloat Boulevard along the ocean beach, a distance of two miles. The greater part of this was noted as complete in last year's report, and work was then under way on paving of the lower roadway, a 40 ft. road, 9750 ft. long. The contract was let on January 10, 1930 to Federal Construction Company and was completed in August, 1930.

Two comfort stations, on which construction was noted last year as 55% complete, were completed by Clinton Stephenson Construction Company on August 16, 1930.

The necessity of further extension of the sea-wall built as part of the Ocean Beach Esplanade was well exemplified by the encroachment of the ocean on the Taraval Street underpass at Great Highway. Shore eddies, set up during a heavy storm, began an encroachment on the beach and lowered the natural sand levels 10 feet. This persisted after the storm and was stopped only by great effort. The measures adopted, that is driving sheet piling and placing riprap, were done at an expenditure at least equal to the original cost of the underpass. Sea-wall construction is very expensive and it has always been with great difficulty that money for this purpose has been secured by appropriation of the Supervisors. This office is now engaged in a study for progressive construction of the sea-wall. Work on the important initial unit, which will protect the upper road, may be undertaken at an early date and its cost defrayed out of the portion of the 1927 bond fund set aside for Great Highway construction.

Van Ness Avenue Extension from Mission Street to Howard Street has progressed materially. Purchase of lands has been completed and contract for the pavement of the roadway was awarded June 24, 1931. This pavement work is to be done at the expense of the property owners. The pavement will consist of 6 inches of concrete base, 1½ inch asphalt binder and 1½ inch asphalt wearing surface. Curbs will be of concrete.

Bernal Cut, the ninth boulevard bond project, was noted in last year's report as complete, except for additional walks and planting.

Boulevard Construction Out of Gasoline Tax:

Laguna Honda Boulevard, on which the temporary pavement was noted as complete in last year's report, is now ready for permanent pavement.

Plans and specifications are under way and it is expected that this work will be done during the present year.

Portola Drive, from Twenty-fourth Street to Fowler Avenue, a distance of 3950 ft., was noted as having received its temporary pavement. After settlement during the coming winter, it is expected that the fills will be ready for this work. Plans and specifications for this work are under way.

It is planned to widen the remaining portion of Portola Drive, that is from Woodside Avenue to Sloat Boulevard, a distance of 7000 ft., to a width of 100 ft. to accommodate the very heavy traffic which reaches it from Market Street Extension. This widening would be a proper charge out of gasoline tax funds.

Road and Boulevard Construction to Relieve Unemployment:

The City of San Francisco took prompt measures to relieve unemployment during the business depression. On February 6, 1931, at a special election, the voters authorized the issuance of bonds for three purposes, as follows:

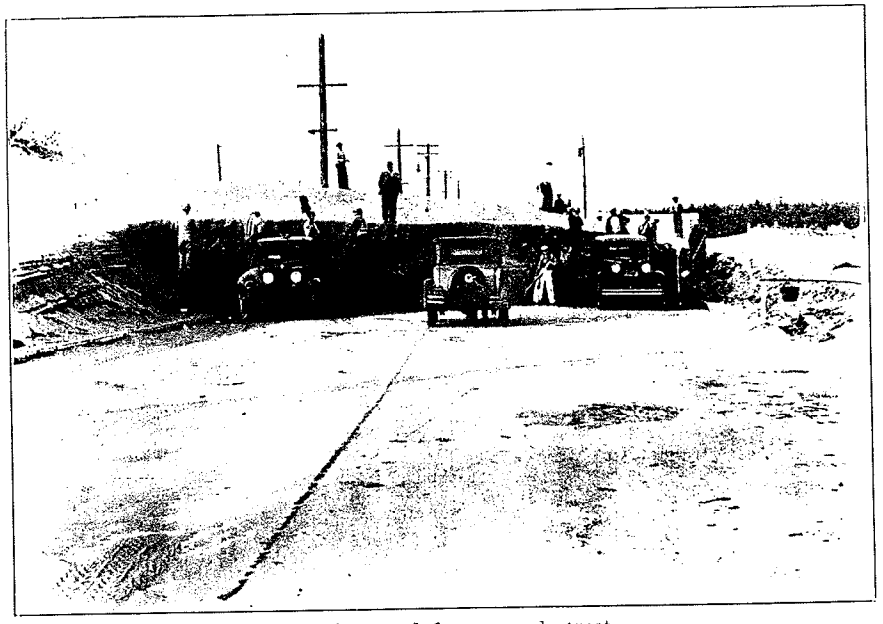
1. Improvement of Paths and Roads in Public Parks and Squares	$1,400,000
2. Construction of Roads and Highways	900,000
3. Improvements in Public Playgrounds	200,000
Total	$2,500,000

Prior to sale of bonds the city advanced sufficient money to begin the work. The bonds sold at a substantial premium. For some time a registration of unemployed citizens had taken place in the City Hall and it was the aim to employ only these men for two weeks continuously at a rate of $4.50 per day for common labor, then to replace them with another contingent, in other words to rotate labor.

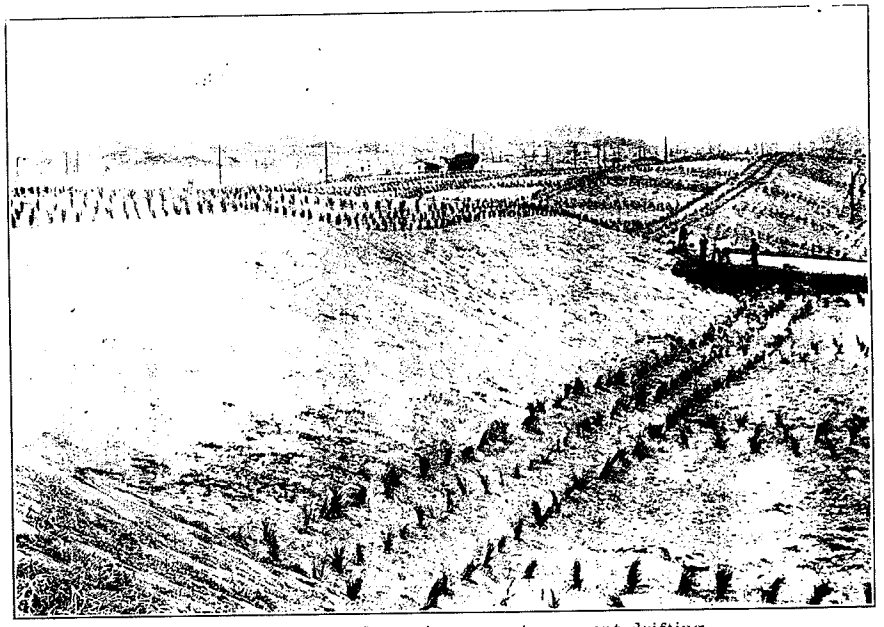
The labor was very inefficient, but fairly satisfactory progress was made in several of the projects outlined. At the present time the funds remaining are depleted to such an extent that on July 3, 1931 work will be discontinued on most of the jobs.

Bernal Heights Boulevard is probably the most striking of these jobs. The boulevard encircles Bernal Heights, the eminence which lies southeast of the Mission District. A roadway of approximately 5,000 ft. length is under construction here. The entire hill is rock and the roadway is made largely in cut in cherts and sandstone with steep rock slopes. There are two 7 ft. sidewalks and a 36 ft. roadway. The grading was done largely by hand labor although in the heavier cuts use was made of a steam shovel and several motor trucks. The view of the city from this boulevard can hardly be excelled as the Bernal hill occupies a central strategic vision point and it will be the more appreciated in that the Heights have been visited by relatively few San Franciscans.

For right of way, 93 lots and 25 houses were purchased at a cost of $71,789.



Removing sand from paved street



Sand dunes planted to wire grass to prevent drifting

WORK TO RELIEVE UNEMPLOYMENT

Clarendon Avenue Extension is a roadway leading from the present termination of Clarendon Avenue near Stanyan Street north of Twin Peaks reservoir through Sutro Forest southwesterly to a junction with Laguna Honda Boulevard, a short distance northerly from Forest Hill station. The road is 60 ft. in width, 3940 ft. long and descends generally on a 10% grade. It traverses the old eucalyptus grove known as Sutro Forest. More than 1000 of these trees, about 65 years old, were cut to 4 ft. lengths, split and piled for use of the Water Department and the Laguna Honda Home. The stumps were blasted and removed to piles for burning. A 12 inch sewer pipe line was constructed, consisting of 1300 ft. of vitrified clay pipe and 500 ft. of cast iron pipe near the reservoir. All necessary catch-basins, culverts, and manholes were built. The road at present is about 95% complete, the remaining portion being a rock cut close to Laguna Honda, that is now being excavated by steam shovels and trucks. The rock surface of the roadway has not yet been rolled.

Lake Merced Boulevard is a roadway extending around the two arms of Lake Merced near the southerly boundary of the County. The boulevard will have a total length of approximately 5 miles but at present only 0.6 mile is under construction. This unit extends from the southerly end of Section A of Sloat Boulevard in a westerly direction to a junction with Skyline Boulevard. During clearing operations 680 eucalyptus trees were cut, split and piled. The right of way is 100 ft. wide and the paved roadway 60 ft. Pavement consists of 10 inches of waterbound macadam (red rock) with redwood headers. This will eventually be the base upon which asphaltic top will be laid for the final boulevard. The work is very good and the surface is quite satisfactory for vehicular traffic.

Stanley Street Parkway is the Panhandle approach to Lake Merced Boulevard from Alemany Boulevard at Orizaba Avenue. At present grading is being done on the easterly portion of this parkway.

Miscellaneous jobs done by the "Unemployed" include: Corbett Road, placing 1700 lin. ft. of 6 in. tile drain in 4 ft. trench which later was backfilled with crushed rock; Golden Gate Heights, Twin Peaks Boulevard, Laguna Honda Boulevard, Mt. Davidson, etc., stairways cleaned, guard fences repaired, slopes redressed, trails cleaned, gutters reestablished; Sutro Forest, 3 miles of fire trails cleared and widened for use of Fire Department; Sunset District, about 4 miles of streets cleared of sand and further protected by planting 750 acres of sandhills to barley and to wire grass. About 400,000 cu. yds. of sand were removed by hand labor and small trucks.

Boulevard and Highway Construction by Joint Highway Districts:

It is the belief of most citizens that all road construction is done by federal, state, county or city governments, but there are other units, the Joint Highway Districts, that are accomplishing much in major highway construction.

These districts are constituted by virtue of an Act of the State Legislature approved in 1917 and amended in 1921, 1925 and 1927, which provides

that joint highway districts composed of two or more counties may be created for the purpose of constructing certain highways. The districts are formed by resolution of the county Boards of Supervisors, from whose membership the District Directors are chosen by the respective boards. These District Directors form an executive body transacting the business of the district as a public corporation under the designation "Joint Highway District No. ..... of the State of California." The districts take numbers in order of their creation by filing the resolution of confirmation by the Counties with the Secretary of State. The Secretary of State assigns the number to the district and issues a certificate of organization.

There are now sixteen districts organized under the state law, of which three include San Francisco County as member. These districts are No. 9, No. 10, and No. 16. Such incidental funds as are necessary are provided by authorization of the Counties' Supervisors from their portion of the State gasoline and motor vehicle tax.

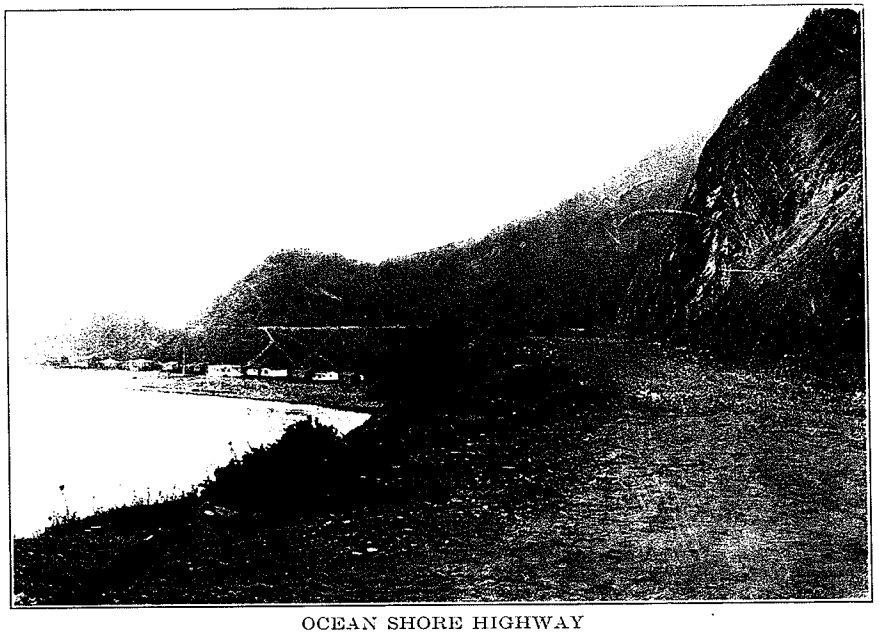
For construction of the highway, the Directors have power to assess the State, the several Counties in the district and such lands as may be benefited by the highway. After review by the State Board of Control, these assessments are mandatory. The Directors are authorized to make necessary surveys and plans and invite bids and to let contracts for construction.

Upon completion of the contract, inspection of the work is made by the Advisory Board of the State Engineering Department which thereupon may issue a certificate of completion. The completed road may then be apportioned to several counties in the district, or be accepted as a whole or in part as state highway. Proper conveyance of all interest and rights of way that the district may have, must then be made by the Directors of the district to the Counties or the State.

Upon the formation of the local districts Nos. 9 and 10, it was anticipated that bonds would be issued under the provisions of the Act. These bonds were called revenue bonds and were predicated upon the receipt of revenues from taxation levied on the Counties. The tax is limited to five cents on $100 of assessed valuation, apparently a rather insignificant amount, but capable of financing a $1,700,000 project over a minimum period of five years, by San Francisco County alone. The legality of this provision was upheld in a test case in Ventura County which established the Districts' right to issue bonds.

The program of construction adopted by the two districts is first to construct the more important or vital portions of the highway in such a way that relief is afforded where it is in greatest demand. Other units are to follow as funds are made available until the entire project is brought to completion.

Ocean Shore Highway is a reconstruction of the present narrow and crooked county road which parallels the ocean shore from San Francisco to Santa Cruz. Joint Highway District No. 9 of the State of California, composed of San Francisco, San Mateo, and Santa Cruz Counties, was formed



OCEAN SHORE HIGHWAY
Old railroad grade along San Pedro Point

for the construction of this road, and these counties will contribute, respectively, 55%, 30%, and 15% of the cost, which is preliminarily estimated at $6,000,000.

The engineering is done by the County Surveyors of San Mateo and Santa Cruz Counties. This office made all preliminary studies and participates in all engineering conferences.

The new road will take off from the Skyline Boulevard, approximately two miles south of the San Francisco-San Mateo County Line. From this point it will descend to the old roadway of the abandoned Ocean Shore Railway which it will follow in a general way to Santa Cruz.

The length of the new highway will be 74 miles which is about 17 miles shorter than the existing road. The right of way will be 100 ft. wide, with a 40 ft. roadway. For many miles it follows along precipitous rocky slopes, which call for very heavy construction but, to a great extent, the roadbed of the old railway will be used. The view afforded from this highway will easily rival any marine drive in the State.

The Directors have selected for initial construction the most vital units, that at San Pedro Mountain, which consists of about 5 miles of road between Rockaway Beach and Farallone City, and at Waddell Beach, about 6 or 8 miles in length, which will avoid the curves and grades over Ginoni Hill on the road through Swanton. Other units planned are the 2-mile section connecting Junipero Serra Boulevard and Skyline Boulevard south

of the San Francisco County line, the realignment of the section 2 or 3 miles in length extending from the Skyline Boulevard south to Salada Beach road, the construction of a road along the old railway right of way in the vicinity of San Gregorio and Pescadero, and permanent improvement of the road along the Waddell Beach bluffs. The present County Road is to be used wherever the alignment and grades are consistent with first class highway design. The construction work will be done under a series of contracts, the costs of which are to be defrayed by assessments levied against the counties from time to time.

The first work undertaken is the San Pedro Mountain unit, about five miles in length, between Rockaway Beach and Farallone City. It was planned to use the abandoned roadbed of the Ocean Shore Railway for this distance, grading it initially to 25 ft. width and even using the old tunnel at Point San Pedro, which is about 500 ft. in length. The timbering is in good condition except at the portals which have caved and will require reconstruction.

The roadway rises on a 2% grade through the tunnel to a summit at Point Rogers ("Devil's Slide") whence it descends to a long fill at Farallone City. The old railroad bench is about 200 to 300 ft. above the ocean on a steep, rocky slope. In many places the old roadbed has slid entirely into the ocean and full reconstruction will be required for the new road.

As noted in last year's report, condemnation proceedings for the required right of way were instituted on June 23, 1930. The Superior Court of San Mateo County set a value of $112,000 which the District Directors thought was excessive, considering the fact that expensive reconstruction work is required on the old railroad roadbed. The value set by the court was fixed largely by the evidence introduced by the owners, Ocean Shore Railroad and the McNee Estate Company, who considered the railroad as of possible useful service in hauling redwood products from the region southerly from Pescadero to San Francisco.

An odd feature of the ownership of this land is the fact that several years ago the McNee Estate agreed to give the right of way to the Highway District when the latter should be ready to proceed with construction of the road. In consideration of this promise the land has been assessed by San Mateo County at but a nominal figure. Since the failure to acquire the right of way from the estate, the San Mateo County Supervisors, sitting as a Board of Equalization, have raised the assessment on this property.

When the Ocean Shore Railway was about to discontinue operation, a number of the coast residents raised by subscription a fund of $150,000 with which it was proposed to buy the entire railroad with rolling stock and all facilities and present it to one of the railroads operating out of San Francisco for that company to operate. The negotiations failed because the company did not consider that the railway could be operated at a profit.

Following the court decision the Highway District abandoned the route along the old railroad roadbed and began to seek for an alternative route. Two such are under consideration and at this time, as surveys are about

to be made of these alternative routes, the owners of the original route sought by condemnation have indicated their willingness to compromise on price and negotiations are now under way.

Considerable difficulty was met in collecting the assessment originally levied for the San Pedro Mountain unit. With a 40 ft. roadbed, the cost was estimated at $670,000. On account of the difficulty of collection, District Engineer Kneese submitted a revised report for a 25 ft. roadbed at an estimated cost of $180,000 for units A and B.

An informal agreement was reached at a Directors' meeting by which $88,000 was to be raised to begin contract work on unit "A" at a cost of $120,000.

Santa Cruz County paid $11,000, and San Francisco County paid $35,000 under this agreement, but on account of legal difficulties, the payment of $42,000 by San Mateo County has not yet been made. Meanwhile, the contract let to A. J. and J. L. Fairbanks, Inc., has been cancelled on account of the high cost of the right of way, which will no doubt take the bulk of the funds on hand.

By reorganizing under the new Joint Highway District Act, signed by the Governor in June, 1931, the way will probably be found out of this financial tangle, as the procedure in financing has been greatly simplified in this new Act.

Junipero Serra Boulevard Extension. This boulevard begins at the San Francisco-San Mateo County line at the southerly end of Junipero Serra Boulevard and extends well south into San Mateo County, lying approximately midway between El Camino Real and Skyline Boulevard, back of the cemeteries. Its construction as far as Burlingame, a distance of 11 miles, at an estimated cost of $2,500,000, is being undertaken by Joint Highway District No. 10. San Francisco, which is obligated to pay 85% of the cost, has two directors, while San Mateo County has one. The City Engineer of San Francisco is Chief Engineer.

The boulevard will be graded to full ultimate width through all built-up areas. Right of way is 125 ft. wide to provide for a 100 ft. paved roadway and two sidewalks 12½ ft. wide. Beyond the built-up areas, the roadway will conform to the standard of the existing state highway, El Camino Real. Here the initial width graded is 75 ft., of which 40 ft. is paved to provide four traffic lanes with peak capacity of 3200 vehicles per hour. The paved roadway may be widened to 60 ft. when traffic justifies it. Grade separation is planned at Washington Street, Colma, where local traffic will pass over the boulevard. Grade separation may be necessary also at Millbrae Avenue. Joint Highway District No. 10 ends at Burlingame.

From Burlingame to Alameda de las Pulgas, at Belmont, a 7 mile gap exists. Half of this distance is through some of the highest class residential tracts in the state. To preserve the values of these properties it will probably be necessary to make a parkway from 200 to 300 ft. wide, which will cost $3,000,000 or more per mile for lands and construction.

San Mateo Creek crossing will require a high viaduct. Eventually the boulevard will be extended to San Jose.

The schedule of construction is laid out on the installment plan in similar manner to that of Ocean Shore Boulevard, that is, there are a number of units of construction, the most vital being undertaken first. For construction purposes this boulevard has been divided into three sections. Section 1 extends about 3½ miles in a southeasterly direction from the county line to a junction with El Camino Real at Baden. Section 2 extends 4 miles from Baden to San Bruno, and Section 3 is 3½ miles long from San Bruno to Burlingame.

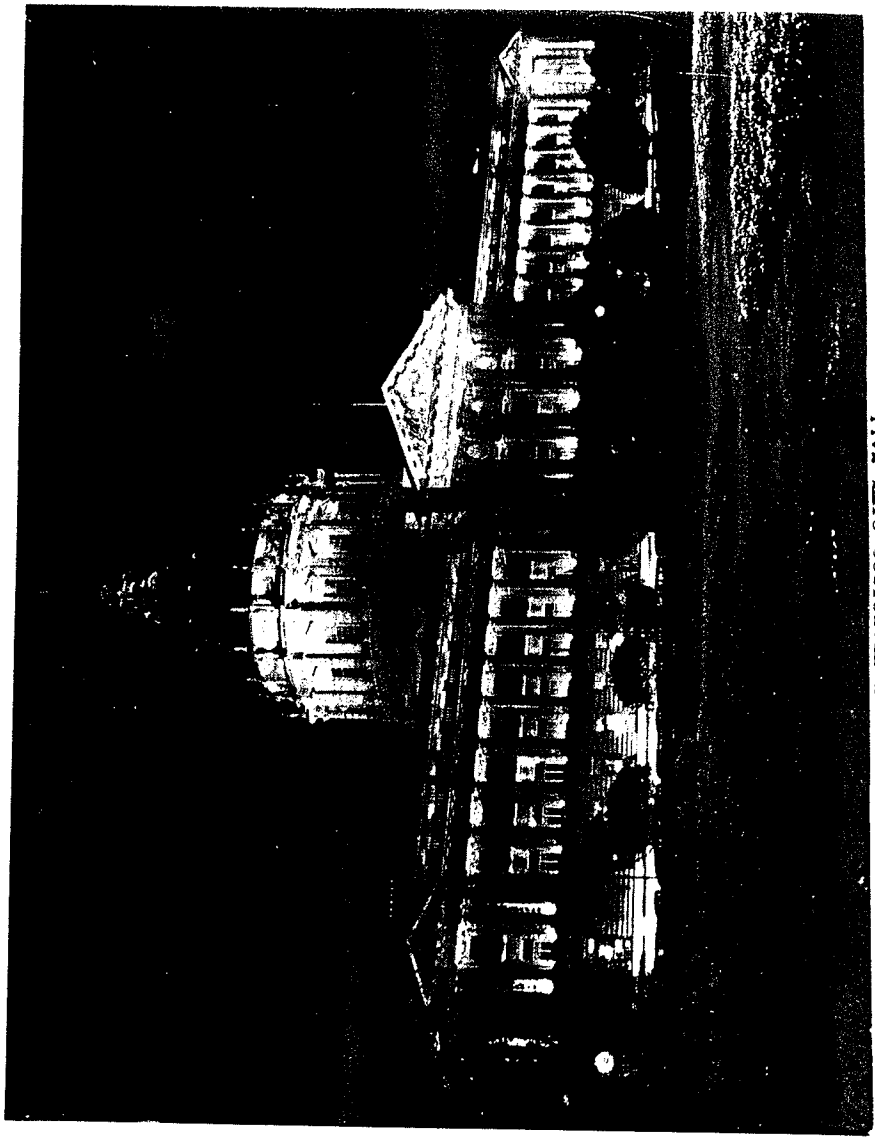
The estimated cost of Section 1 was $800,000, an amount that it was difficult to finance at one time. This section was therefore divided into three units, A, B, and C. Unit A from the County line to School Street, was noted in last year's report as completed. Traffic counts here show 4,000 to 5,000 vehicles daily during week days and up to 20,000 on holidays; this in spite of an objectionable right angle turn at the School Street termination. With the construction of the other units this traffic will undoubtedly increase so that this boulevard will be one of the most important peninsular arteries.

Unit B is ⅔ mile in length from School Street to Edgemar Road. Assessment for its estimated cost of $230,000 was made March 20, 1931. San Mateo County's share, $23,000, was paid in advance. The State Department of Public Works agreed to pay one-third of the cost or $76,667. San Francisco's share $140,000, is not yet available, due to depletion of the gasoline tax fund. Purchase of rights of way, estimated at $90,000 is going ahead satisfactorily, plans and specifications are ready, and contract should be entered into before the end of this summer.

Unit C extends from Colma to Baden, with a connection to El Camino Real. Efforts are now being made to finance the purchase of rights of way for this unit and for Sections 2 and 3 extending to Burlingame. It is essential that these purchases be made soon to avoid rise in prices due to subdivision of the lands, and that the construction proceed rapidly, as the boulevard will soon be urgently needed.

North Shoreline Joint Highway District. Efforts were made to form a joint highway district for construction of a road from the Golden Gate, along the Bolinas Ridge, and then following the shore line to join the Redwood Highway at Ferndale, near Eureka. The district was to consist of San Francisco, Marin, Sonoma, Mendocino, and Humboldt Counties. Due to the fact that there were no data on hand to form a basis of cost, the district never progressed beyond tentative formation.

One unit of the proposed highway is a bridge crossing Russian River at Jenner, near the ocean. Joint Highway District No. 16, known as Russian River Bridge Crossing District, was formed to construct this unit. The component counties and the State contributed funds for this work as follows: Marin $12,500, Sonoma $85,000, Mendocino $12,500, San Francisco $15,000, and the State of California $65,000.



SAN FRANCISCO CITY HALL

ANNUAL REPORT

OF THE

BUREAU *of* ENGINEERING

OF THE

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF
SAN FRANCISCO

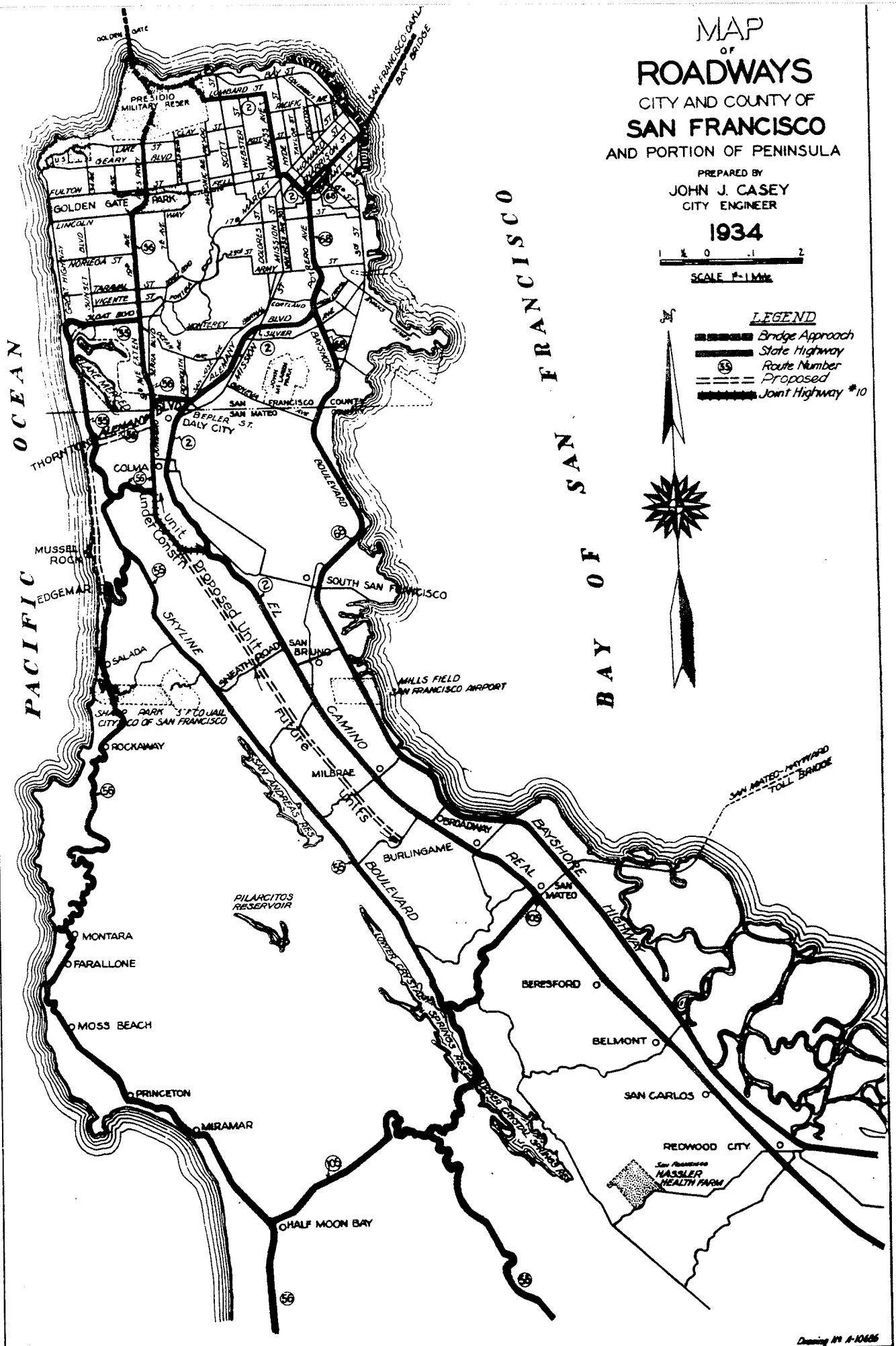
FISCAL YEAR ENDED JUNE 30, 1934

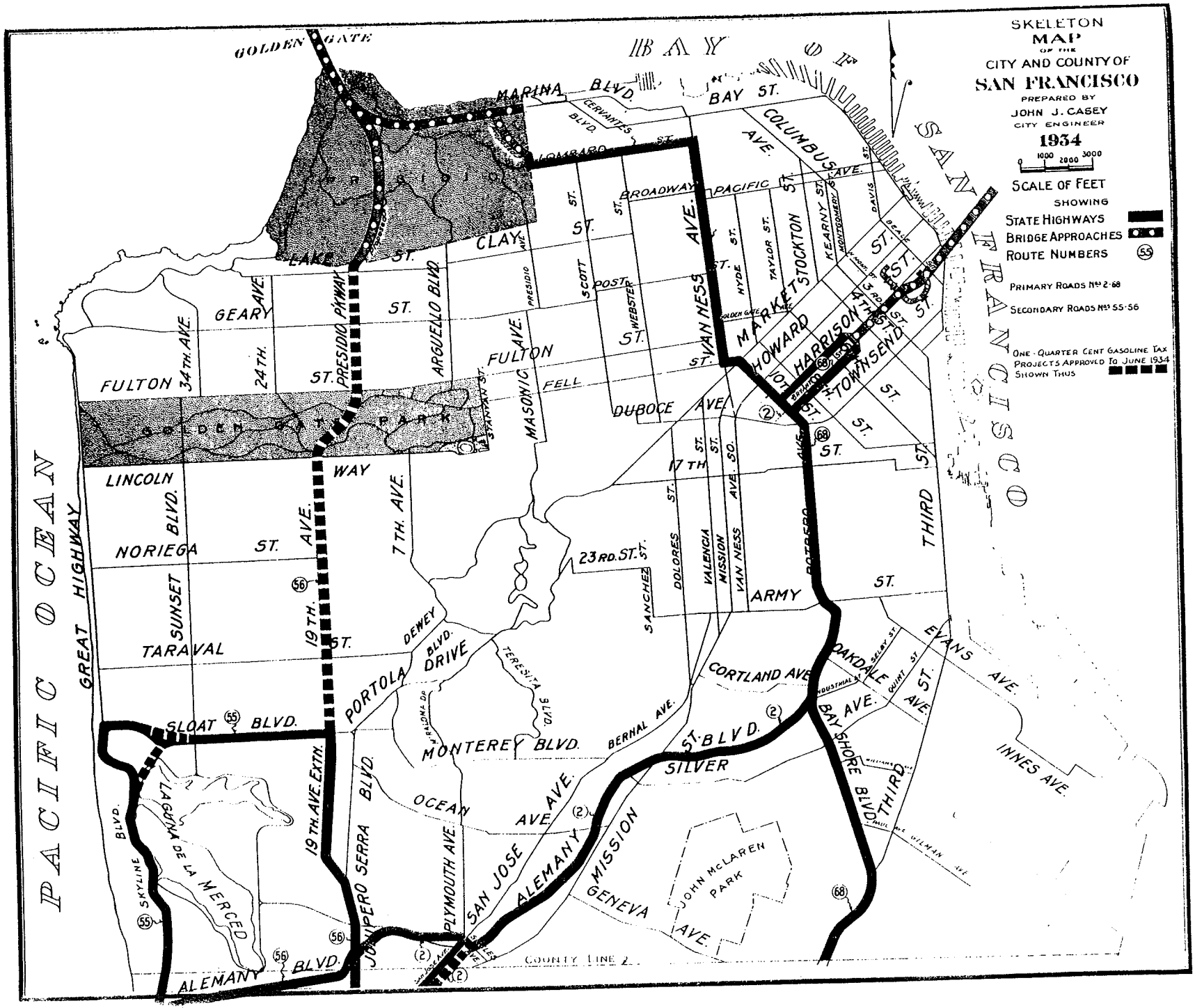
ANGELO J. ROSSI — *Mayor*

ALFRED J. CLEARY — *Chief Administrative Officer*

WILLIAM H. WORDEN — *Director of Public Works*

JOHN J. CASEY
City Engineer


MAP
OF
ROADWAYS
CITY AND COUNTY OF
SAN FRANCISCO
AND PORTION OF PENINSULA
PREPARED BY
JOHN J. CASEY
CITY ENGINEER
1934
SCALE 1" = 1 Mile
LEGEND
Bridge Approach
State Highway
Route Number
Proposed
Joint Highway #10
PACIFIC OCEAN
BAY OF SAN FRANCISCO
GOLDEN GATE
SAN FRANCISCO-OAKLAND BAY BRIDGE
PRESIDIO MILITARY RESER
GOLDEN GATE PARK
COLMA
DALY CITY
SAN MATEO
SOUTH SAN FRANCISCO
SAN BRUNO
MILLS FIELD SAN FRANCISCO AIRPORT
MUSSEL ROCK
EDGEMAR
SALADA
ROCKAWAY
MILBRAE
BURLINGAME
SAN MATEO
BELMONT
SAN CARLOS
REDWOOD CITY
BERESFORD
MONTARA
FARALLONE
MOSS BEACH
PRINCETON
MIRAMAR
HALF MOON BAY
PILARCITOS RESERVOIR
THORNTON
SKYLINE
BOULEVARD
CAMINO REAL
BAYSHORE HIGHWAY
SAN MATEO-HAYWARD TOLL BRIDGE
Unit Under Construction
Proposed Unit
Future
Sites
HASSLER HEALTH FARM
Drawing No. A-10686


SKELETON
MAP
OF THE
CITY AND COUNTY OF
SAN FRANCISCO
PREPARED BY
JOHN J. CASEY
CITY ENGINEER
1934
1000 2000 3000
SCALE OF FEET
SHOWING
STATE HIGHWAYS
BRIDGE APPROACHES
ROUTE NUMBERS
PRIMARY ROADS Nos 2-68
SECONDARY ROADS Nos 55-56
ONE-QUARTER CENT GASOLINE TAX PROJECTS APPROVED TO JUNE 1934 SHOWN THUS
BAY OF SAN FRANCISCO
PACIFIC OCEAN
GOLDEN GATE
MARINA BLVD.
BAY ST.
COLUMBUS AVE.
BROADWAY
PACIFIC ST.
CLAY ST.
LAKE ST.
GEARY ST.
FULTON ST.
PRESIDIO PKWAY
ARGUELLO BLVD.
VAN NESS AVE.
MARKET
STOCKTON
HOWARD
HARRISON
TOWNSEND
3RD ST.
4TH ST.
GOLDEN GATE PARK
LINCOLN WAY
FULTON
FELL
DUBOCE AVE.
17TH ST.
NORIEGA ST.
7TH AVE.
19TH AVE.
GREAT HIGHWAY
SUNSET
TARAVAL ST.
23RD ST.
ARMY ST.
THIRD ST.
DOLORES ST.
VALENCIA ST.
MISSION ST.
VAN NESS AVE. SO.
POTRERO AVE.
SANCHEZ ST.
DEWEY BLVD.
PORTOLA DRIVE
TERESITA BLVD.
SLOAT BLVD.
CORTLAND AVE.
OAKDALE AVE.
EVANS AVE.
BAY SHORE BLVD.
INNES AVE.
MONTEREY BLVD.
BERNAL AVE.
SILVER AVE.
OCEAN AVE.
19TH AVE. EXTN.
LAGUNA DE LA MERCED
SKYLINE BLVD.
JUNIPERO SERRA BLVD.
PLYMOUTH AVE.
SAN JOSE AVE.
ALEMANY BLVD.
MISSION
GENEVA AVE.
JOHN McLAREN PARK
COUNTY LINE